200

CONFIDENTIAL

NON-REGISTERED

INSTRUCTION BOOK

FOR

ACCESSORY CONTROL UNIT

FOR OPTIONAL USE WITH

SO-SERIES RADAR EQUIPMENT

SHIPS 247

MANUFACTURED FOR

U. S. Navy Department — Bureau of Ships

BY

RAYTHEON MANUFACTURING COMPANY
WALTHAM, MASSACHUSETTS
U. S. A.

Contracts: NXsr-39226
NXsr-(LL)-43375

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DANGER— High Voltages

Operation of this equipment involves the use of high voltages which are dangerous to life. Operating personnel must at all times observe all safety regulations. Do not change tubes or make adjustments inside equipment with high voltage supply on. Do not depend upon door switches or interlocks for protection but always shut down motor generators or other power equipment. Under certain conditions dangerous potentials may exist in circuits with power controls in the off position due to charges retained by capacitors, etc. To avoid casualties, always remove power, discharge and ground circuits prior to touching them.

RECORD OF CORRECTIONS

Change No. or Reg. Publ. Memo.	Entered By	Date

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REPORT OF FAILURE

Report of failure of any part of this equipment, during its service life, shall be made to the Bureau of Ships in accordance with current instructions. The report shall cover all details of the failure and give the date of installation of the equipment. For report of failures during the specified guarantee period, see Bureau of Engineering Circular Letter No. 40b, dated January 16, 1939, or subsequent revisions thereof.

In order to expedite the handling of requisitions in the Bureau of Ships, the requisitions for replacement material should include complete descriptive data covering the part desired, in the following form:

Name of part; ratings; type number with prefix and suffix designation, if practicable; the complete model designation of the equipment, including suffix or prefix designation in which the part is used; symbol number of the part; and page number of the instruction book in which part is described.

PERTINENT DATES

The blank spaces indicated below should be filled in immediately upon completion of the initial service installation. The date of acceptance by the Navy can be determined by the stamped acceptance plate located on the panel of the equipment.

CONTRACT.....DATE OF CONTRACT.....

SERIAL NUMBER OF EQUIPMENT.....

DATE OF ACCEPTANCE BY THE NAVY.....

DATE OF DELIVERY TO CONTRACT DESTINATION.....

DATE OF COMPLETION OF INSTALLATION.....

DATE PLACED IN SERVICE.....

DATE OF EXPIRATION OF CONTRACTUAL GUARANTEE .....

SAFETY PRECAUTIONS

Since the use of high voltages which are dangerous to human life is necessary to the successful operation of the radio transmitting equipment covered by these instructions, certain reasonable precautionary measures must be carefully observed by the operating personnel during the adjustment and operation of the equipment.

It should be borne in mind that interlocks are provided only on normal access doors on certain major units. Therefore side, back or top screens, commutator covers, if removed, will not cause interlocks to function and will thereby allow access to circuits carrying voltages dangerous to human life.

The major portions of the equipment are within shielding enclosures, provided where necessary with access doors which are generally fitted with safety interlock switches which act to shut off dangerous voltages within the enclosures when the access doors are open.

While every practicable safety precaution has been incorporated in this equipment, the following rules must be strictly observed.

KEEP AWAY FROM LIVE CIRCUITS. Under no circumstances should any person be permitted to reach within, or in any manner gain access to, the enclosure with interlocked gates or doors closed or with power supply line switches to the equipment closed; or to approach or handle any portion of the equipment which is supplied with power, or to connect any apparatus external to the enclosure to circuits within the equipment; or to apply voltages to the equipment for testing purposes while any non-interlocked portion of the shielding or enclosure is removed or open. Wherever feasible in testing circuits, check for continuity and resistance rather than directly checking voltage at various points.

DON'T SERVICE OR ADJUST ALONE. Under no circumstances should any person reach within or enter the enclosure for the purpose of servicing or adjusting the equipment without the immediate presence or assistance of another person capable of rendering aid.

DON'T TAMPER WITH INTERLOCKS. Under no circumstances should any access gate, door or safety interlock switch be removed, short-circuited, or tampered with in any way, nor should reliance be placed upon the interlock switches for removing voltages from the equipment.

THE ATTENTION OF OFFICERS AND OPERATING PERSONNEL IS DIRECTED TO THE BUREAU OF SHIPS MANUAL OF ENGINEERING INSTRUCTIONS, CHAPTER 31 (MIMEOGRAPHED FORM OR SUBSEQUENT REVISIONS THEREOF) ON THE SUBJECT OF "RADIO-SAFETY PRECAUTIONS TO BE OBSERVED."

GUARANTEE

The equipment including all parts and spare parts, except vacuum tubes, batteries, rubber and material normally consumed in operation, is guaranteed for a period of one year from the date of delivery of the equipment to and acceptance by the Government with the understanding that all such items found to be defective as to material, workmanship or manufacture will be repaired or replaced, f.o.b. any point within the continental limits of the United States designated by the Government, without delay and at no expense to the Government; provided that such guarantee will not obligate the Contractor to make repair or replacement of any such defective items unless the defect appears within the aforementioned period and the Contractor is notified thereof in writing within a reasonable time and the defect is not the result of normal expected shelf life deterioration.

To the extent the equipment, including all parts and spare parts, as defined above, is of the Contractor's design or is of a design selected by the Contractor, it is also guaranteed, subject to the foregoing conditions, against defects in design with the understanding that if ten per cent (10%) or more of any such said item, but not less than two of any such item, of the total quantity comprising such item furnished under the contract, are found to be defective as to design, such item will be conclusively presumed to be of defective design and subject to one hundred per cent (100%) correction or replacement by a suitably redesigned item.

All such defective items will be subject to ultimate return to the Contractor. In view of the fact that normal activities of the Naval Service may result in the use of equipment in such remote portions of the world or under such conditions as to preclude the return of the defective items for repair or replacement without jeopardizing the integrity of Naval communications, the exigencies of the Service, therefore, may necessitate expeditious repair of such items in order to prevent extended interruption of communications. In such cases the return of the defective items for examination by the Contractor prior to repair or replacement will not be mandatory. The report of a responsible authority, including details of the conditions surrounding the failure, will be acceptable as a basis for affecting expeditious adjustment under the provisions of this contractual guarantee.

The above one year period will not include any portion of time the equipment fails to perform satisfactorily due to any such defects, and any items repaired or replaced by the Contractor will be guaranteed anew under this provision.

Section 1—Description

INTRODUCTION

This book describes Accessory Control Unit CRP-23ADZ, which is used with Models SO, SO-a, SO-1, SO-2, SO-8 and SO-13 Radar Equipments. Other types of A.C.U. are slightly different, as outlined below on this page, but the text on Installation, Operation, Theory, and Maintenance applies to all types.

The Accessory Control Unit (A.C.U.) is intended for optional use with SO-Series Radar Equipment. Its chief purpose is to enable determination of range with greater accuracy than the fixed range marks permit.

Means are provided for superimposing a movable "accurate range mark" on the PPI tube. This range mark becomes the "range ring" when the sweep rotates. By turning a hand-crank, the accurate range mark is moved back and forth along the PPI sweep, thus expanding or contracting the range ring until the latter coincides with (cuts across) the signal to be ranged. Accurate range is then read directly from a dial geared to the hand-crank.

The Accessory Control Unit is also used: (a) to indicate the output voltage of the 400-cycle Alternator or the line voltage input to 60-cycle systems; (b) to control external IFF equipment when used; (c) to control the ship heading flash circuit which is provided when a true-bearing system is installed; and (d) to house special controls for equipments operating on the X-band (SO-3, SO-4, SO-12M, etc.).

The Accessory Control Unit is supplied in seven models, which differ in minor details. The differences pertain to: (a) type of input power required, (b) type of mounting, and (c) inclusion of minor controls for X-band operation. All significant differences between models are shown in the photographs and in the following table:

Navy Type No.	*Power Requirements (115 Volts)*	*Mounting*	*X-Band Controls**
CRP-23ADZ	400 cycle	Rack mounting	Omitted
CRP-23ADU	400 cycle	Shelf mounting	Omitted
CRP-23ADU-1 (Supersedes '23ADU)	400 cycle	Shelf mounting	Omitted
CRP-23AEE	400 cycle	Rack mounting	Included
CRP-23AEF	60 cycle	Rack mounting	Omitted
CRP-23AEG	60 cycle	Shelf mounting	Included
CRP-23AFD	60 cycle	Rack mounting	Included

**TUNE Button S-701, TUNE Switch S-705, and A.F.C.–MANUAL Switch S-706.*

The Accessory Control Unit is supplied with SO-Series Equipments only when specified by the Bureau of Ships. Since it performs both functions of the IFF Control Unit and Line Voltmeter, the latter unit is not required when the A.C.U. is installed.

1.0 FUNCTIONAL OPERATION

Refer to the block diagram (Fig. 1).

A negative square wave, triggered by the transmitted pulse, is generated in the Plan Position Indicator Unit by the square-wave multivibrator V-401A and B.

This square wave is delivered to the A.C.U., where it gates a linear saw-tooth generator. The saw-tooth voltage is impressed on a pick-off diode which conducts when the saw-tooth voltage equals its cathode voltage. The cathode voltage of the diode is controlled by a

potentiometer which is geared to the range dial and hand-crank. When the diode starts to conduct, a small pip is formed. This is amplified and used to trigger a blocking oscillator, the output of which is in the form of a sharp pulse. The amount of trigger delay is controlled by the setting of the range potentiometer. This delayed pulse is delivered to the Indicator where it is applied to the PPI tube via the video amplifier. As a result, a spot appears on the screen along the radial sweep. This spot is the movable range mark, which becomes the range ring when the sweep rotates. The range ring expands or contracts as the hand-crank is rotated. The range dial (geared to the hand-crank) gives a reading proportional to the distance of the range ring from the center of the tube. This relation is such that the range dial is calibrated directly in thousands of yards.

1.1 LOCATION OF COMPONENTS

Each unit in SO-Series Equipments has been assigned its own identifying number series, and each component in a unit bears a number within that series. The Accessory Control Unit has been assigned the 700 series, and each of its components is identified by a number between 701 and 799, preceded by a letter designating the functional classification of that component. (These letter designations are listed in all general instruction books for SO-Series Equipments.) For example, T-702 is the power supply transformer.

1.2 PHYSICAL CHARACTERISTICS

The A.C.U. is housed in a watertight case similar to the one used on the SO-Series Plan Position Indicator. The unit is 9½″ high, 19″ wide, and 23½″ deep. It weighs approximately 55 lbs. Details of construction are shown in the photographs.

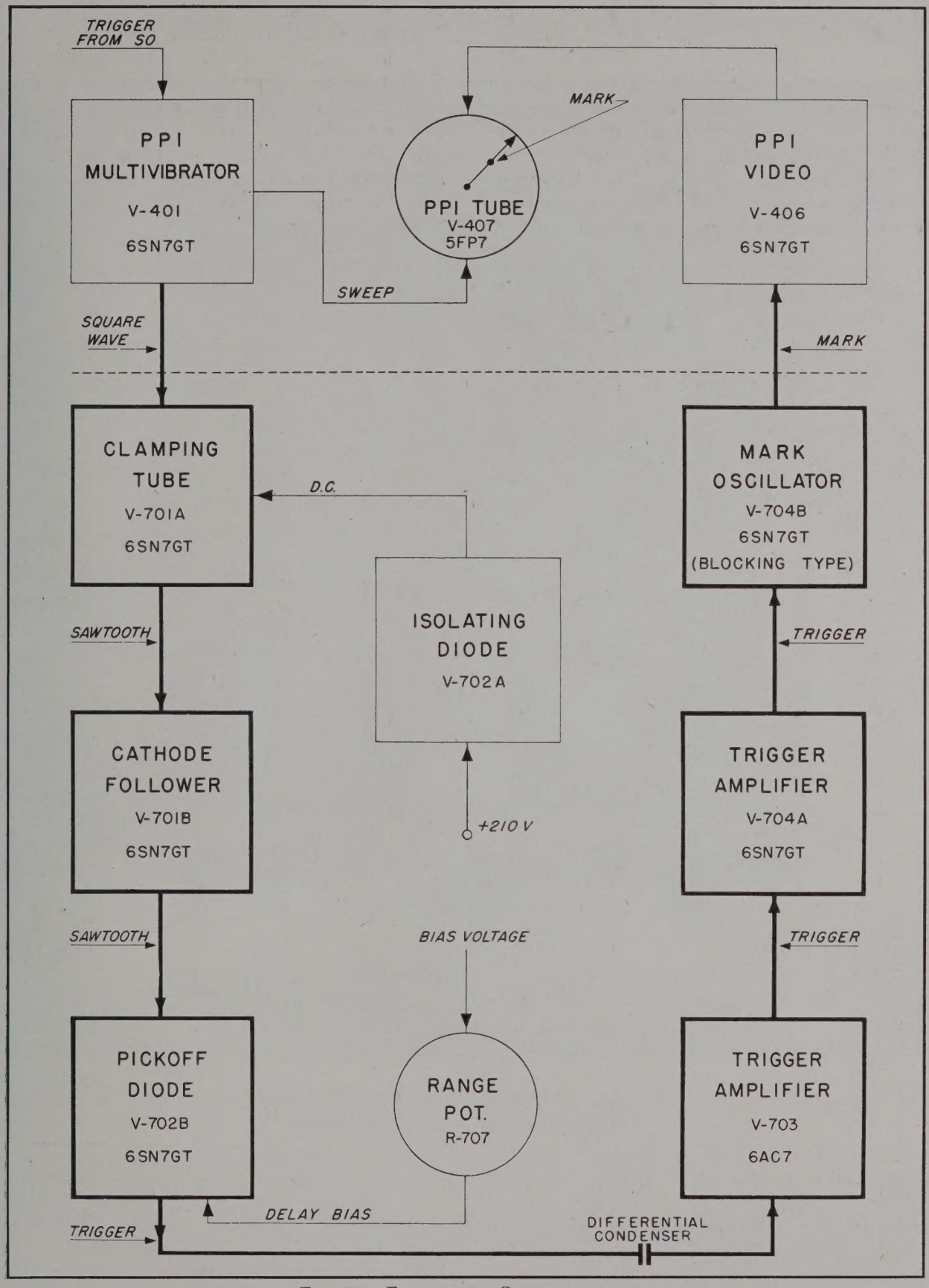


Fig. 1 — Functional Operation.

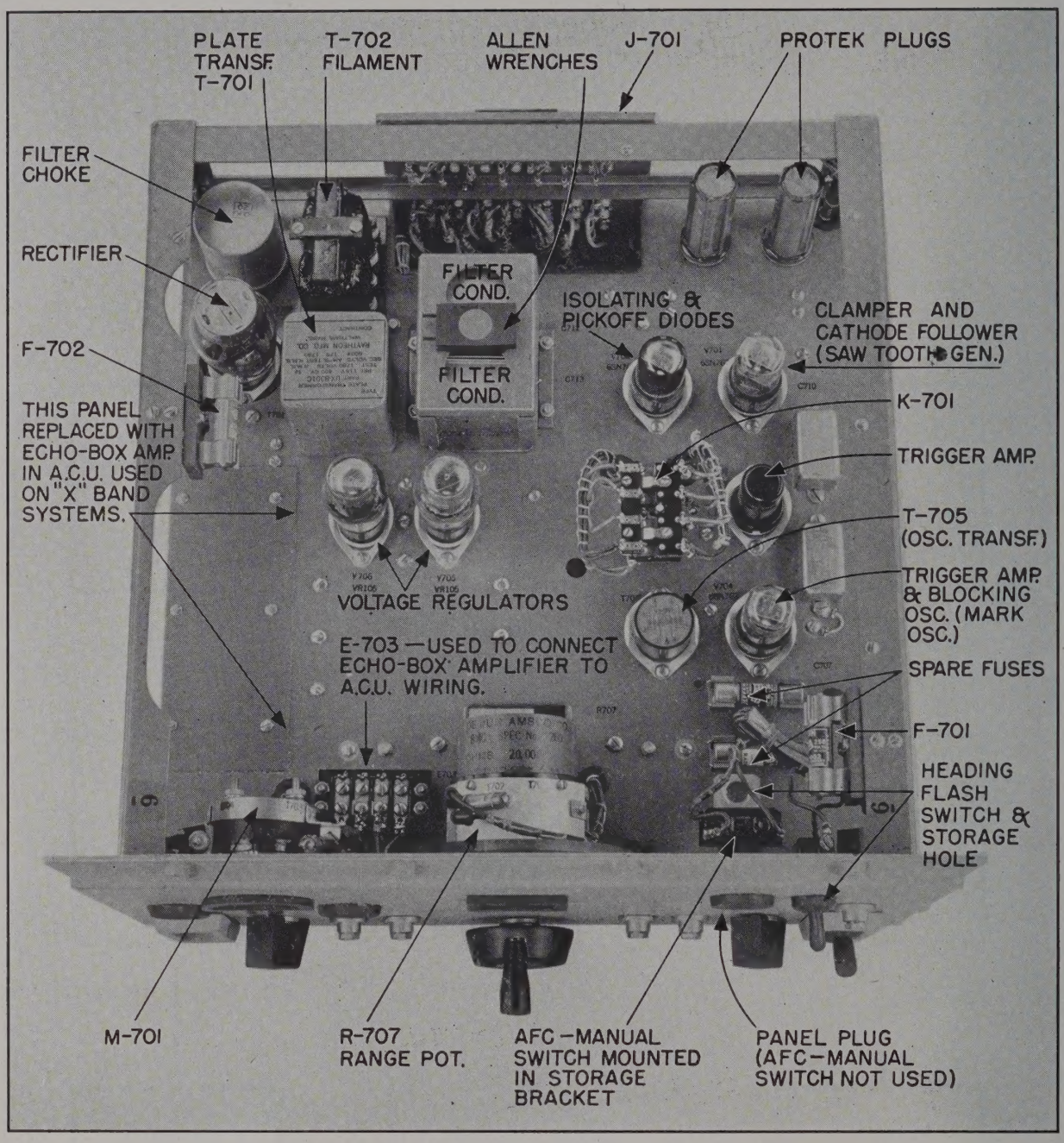


FIG. 2 — ACCESSORY CONTROL UNIT CRP-23ADZ. (400-CYCLE MODEL): TOP VIEW OF CHASSIS.

Section 2—Installation

2.1 POWER REQUIREMENTS

Accessory Control Units CRP-23ADZ, 'AEE, 'ADU, 'ADU-1 operate from a 115-volt 400-cycle source obtained from the SO-Series Motor-Alternator. Each consumes about 85 watts.

Types CRP-23AEF, 'AEG, 'AFD operate from a 115-volt 60-cycle supply. Each consumes about 85 watts. No on-off switch is provided on any model, the unit being on whenever the 400-cycle Motor-Alternator is operating, or (in 60-cycle systems) whenever the main contactor is closed.

2.2 INSTALLATION

A mounting rack is supplied with each A.C.U. for installing the A.C.U. above the Indicator. When thus combined, the two units occupy a space 19¼″ wide, 21½″ high, and 24¼″ deep. The units with mounting frame weigh 175 lbs.

Clearance must be provided for cables to enter the two junction boxes on the rear of the units.

The Indicator and A.C.U. are interconnected by a cable passing through a pipe between the two watertight junction boxes. The pipe is a special section of flanged conduit which is supplied with the necessary gaskets and hardware. The pipe length varies with the type of mounting and the type of A.C.U. used. The interconnecting cable is also supplied.

The procedure for installing the two units in the mounting rack is given below, the key letters referring to Figs. 3 and 4.

(a) Remove the present Indicator and its mounts.

(b) Withdraw the indicator chassis and A.C.U. chassis from their cases and turn the A.C.U. case upside down.

(c) Place the mounting rack upside down on the A.C.U. case.

(d) Insert the clamps A into the slots in the angles on the bottom of the A.C.U. case and tighten securely with the elastic stop nuts furnished.

(e) Before mounting the Indicator, make sure that a 1¼″ hole has been drilled in the top of the terminal box B (on the rear of the indicator case) to receive the cable pipe C between the two cases. If not, drill this hole now, using the template provided. The phenolite plug panel inside the terminal box must be carefully protected from metal shavings, and any shavings remaining must be removed. Make sure to cut the hole clean and true.

(f) Remove both terminal boxes B and D from the rear of the cases to permit insertion of the cable pipe C and making up of the terminal tubes.

(g) Turn the indicator case upside down and slide it into the mounting rack (which is still upside down) to the position illustrated.

(h) Apply the lower clamps A securing the indicator case to the mounting rack and partially tighten.

(i) Install the two positioning clamps E. If necessary to obtain a fit, smooth off the excess weld material on the top front corners of the indicator case around the captive nut channel, using a heavy rasp. Draw up all clamps tight on the bottom of the indicator case, thus securing the case to the mounting rack.

(j) Attach the four new shock mounts F and tighten securely, then turn the mounting rack right side up.

(k) Loosely attach one of the terminal boxes (either B or D) to the corresponding case, making sure to replace the centering pins. Slip one of the furnished neoprene gaskets over each end of the cable pipe C to the shoulder. Then insert the cable pipe into the attached terminal box.

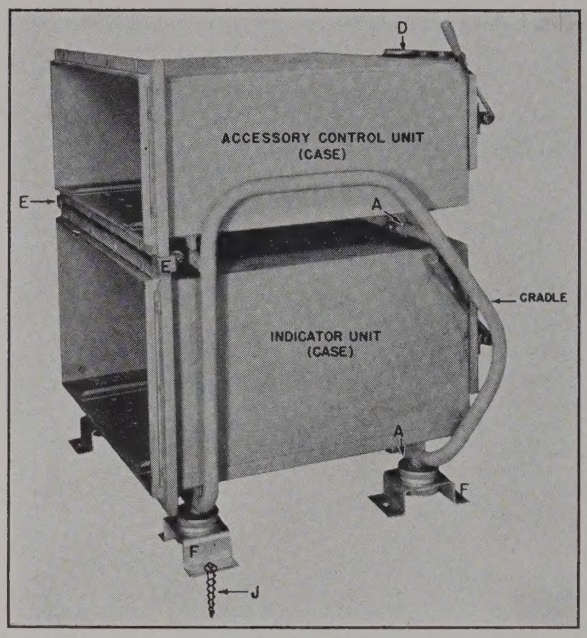


FIG. 3—ACCESSORY CONTROL AND INDICATOR UNITS: MOUNTING DETAILS. (One shock mount is turned 90° from normal position.)

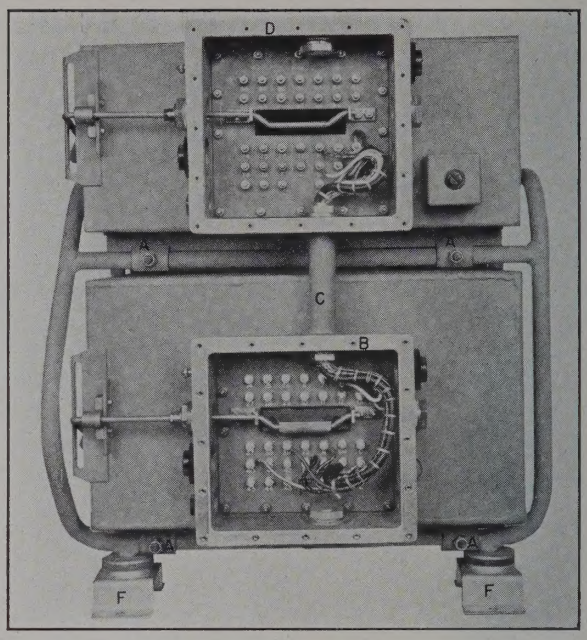


FIG. 4 — ACCESSORY CONTROL AND INDICATOR UNITS: MOUNTING AND CABLING DETAILS.

(l) Slip the other terminal box over the cable pipe and loosely attach the box to the corresponding case, making sure to replace the centering pins.

(m) Tightly secure both boxes to their cases.

(n) Attach the furnished washers and nuts on each end of the cable pipe and take up evenly on both ends of the pipe until a snug fit is obtained.

(o) Locate the mounting rack in approximately its final position and install the interunit wiring through the cable pipe (see Sec. 2.3 Cabling). Use the cable shipped in the A.C.U. terminal box and note that the shield of this cable must be paralleled by a separate lead to insure a positive interunit ground.

(p) Replace and secure the covers on the two terminal boxes.

(q) Position the mounting frame on its anchorage, rotate the four shock-mount feet F to the required mounting position, and secure the feet to the anchorage by means of lag screws J or bolts.

2.3 CABLING

Cabling connections are shown on cabling diagrams, which have been individually prepared for the different models of SO-Series Equipment with which A.C.U.'s have been ordered. Appropriate diagrams are included in recent instruction books covering main equipment.

The following is a list of cabling diagrams for connecting A.C.U. CRP-23ADZ to various SO-Series Equipments:

Main Equipment	*Drawing No.*
SO-a	C-3-1; C-3-2; C-3-3
SO-1	C-4-8; C-4-9; C-4-10; C-4-11
SO-2	C-11-1
SO-8	C-23-3; C-23-4; C-23-5
SO-13	C-43-7; C-43-8; C-43-9

Cabling connections between the A.C.U. and the Indicator should consist of eight wires plus a length of coaxial cable running from terminal J or D on J-401 to terminal DJ on J-701. This cable should pass through the interconnecting pipe. A cable of the proper length is supplied complete with lugs ready for installation.

Cabling from the A.C.U. to other units should be installed in accordance with standard marine practice. Entrance to the A.C.U. junction box should be made by means of watertight terminal tubes. Sufficient slack should be left so that the mounting frame can be moved to give access to the terminal boxes for servicing.

2.4 SPECIAL CONNECTIONS

Certain connections will differ depending on the particular SO-Series Equipment with which the A.C.U. is used. For instance, the Model SO Radar Receiver delivers a positive output and is connected to the grid of the first video stage V-406A in the Indicator through terminal D on P-401. The second input to the video amplifier, terminal J (cathode of V-406A), must then receive negative impulses. As this is the only other video input, the A.C.U. output must be made negative for connection to it. This negative polarity is obtained by strapping output terminal *e* on E-701 to terminal *d*, which is negative.

On other SO-Series Equipments, the receiver output is negative, and consequently the A.C.U. output must be positive. To obtain this polarity, the strapping on E-701 must be shifted to *f* and *e*, and connected to terminal D on P-401. The output from the Receiver must then connect to terminal J on P-401.

Proper connections to Indicator CRP-55ADQ or the modified Indicator CRP-55ADS are shown in Fig. 17.

In SO-Series installations where a Bearing Control Unit (true-bearing kit) has been provided, a circuit is included for placing an Own Ship's Course line (heading flash) on the true-bearing PPI picture. The flasher circuit is disabled by switch S-704 in the A.C.U. To prevent low gain in the indicator video amplifier when the flasher circuit is *not* used, Indicators are shipped with the flasher leads short-circuited by a jumper. When the A.C.U. and Bearing Control Unit are installed, and the flasher circuit in the Antenna is wired in, this jumper must be removed. In some of the early CRP-55ADQ Indicators this jumper is found between ground and the junction point of R-463, R-464, and R-493; on later models it is placed between terminal 98 on P-401 and ground. *This jumper must be removed before the ship heading flash will operate.* After installation of the flasher circuit, switch S-704 grounds the circuit when turned to "Off."

The installation of the A.C.U. replaces the IFF Control Unit and Line Voltmeter CRP-23ADD. The IFF gain control must be removed from the IFF Control Unit and installed in the marked position on the A.C.U. panel. The two IFF controls on the A.C.U. then operate in the same manner as those on the other unit.

Switch S-706 (marked A.F.C.-MANUAL) connects the automatic frequency control provided for the local oscillator on X-band equipments only. When this switch is turned to "Off," the a.f.c. circuit is cut out and the Receiver must be tuned manually. On equipments not operating on the X-band, this switch and its accompanying circuit are not used.

Switch S-705 (marked TUNE) controls the motor used on remotely-tuned X-band Resonance Chambers. Push button switch S-701 (marked TUNE) connects the line voltmeter on the A.C.U. panel to the resonance chamber amplifier to indicate resonance chamber tuning.

These three switches are used only on X-band equipments, such as SO-3, SO-4 and SO-12M/'N Radars.

In addition to the switches a small subchassis containing a two-tube pulse and metering amplifier is included in the X-band models. This assembly is called the resonance chamber amplifier and can be added to any type of A.C.U. if required.

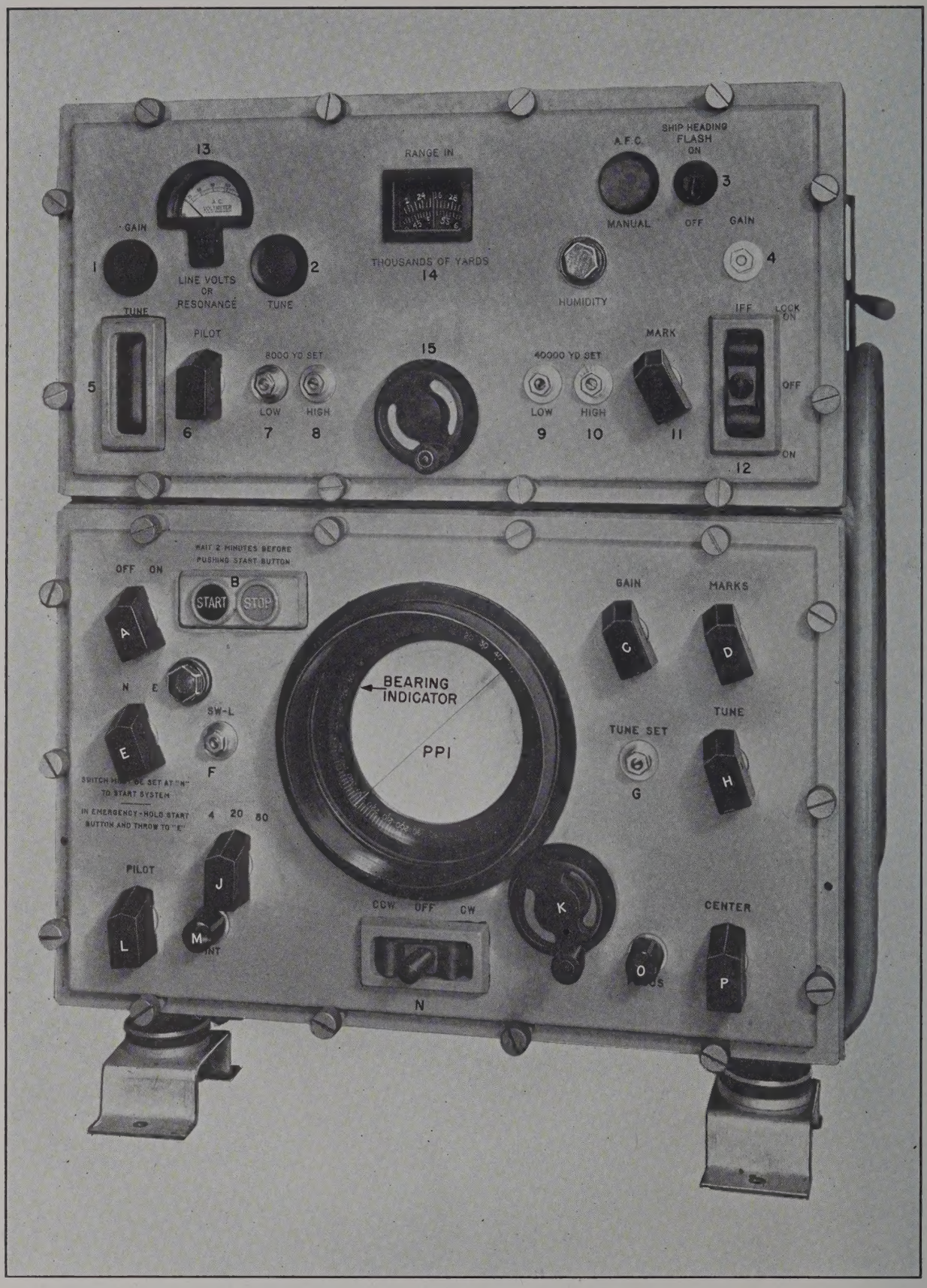


FIG. 5 — ACCESSORY CONTROL UNIT CRP-23ADZ AND INDICATOR UNIT: CONTROL PANELS. (Controls are numbered or lettered for reference to the operating procedures.)

Section 3 — Operation

3.0 GENERAL

It is assumed that the reader already knows the locations and functions of the operating controls on the particular SO-Series Equipment with which the Accessory Control Unit is to be used. (If not, see the instruction book for the main equipment.)

Since the Indicator and the A.C.U. must be adjusted together, these instructions for the use of the A.C.U. will begin with a review of instructions for adjusting the Plan Position Indicator.

Controls located on the Indicator and A.C.U. are shown in the photograph (Fig. 5), with letters or numbers keyed to the text. In this text, control names copied exactly from the panel markings are capitalized thus: "MARKS Control"; control names not appearing on a panel are printed thus: "Antenna Switch."

3.1 OPERATING ADJUSTMENTS ON INDICATOR

With the equipment started and the Modulator operating, proceed as follows:

(a) Turn INT (Intensity) Control M clockwise until the trace is just visible on the PPI.

(b) Adjust FOCUS Control O until the sweep is as sharp and clear as possible.

(c) Turn GAIN Control C clockwise to about mid-scale.

(d) Set TUNE Control H to about mid-scale.

(e) Turn MARKS Control D clockwise until marker dots of moderate brilliance appear along the trace.

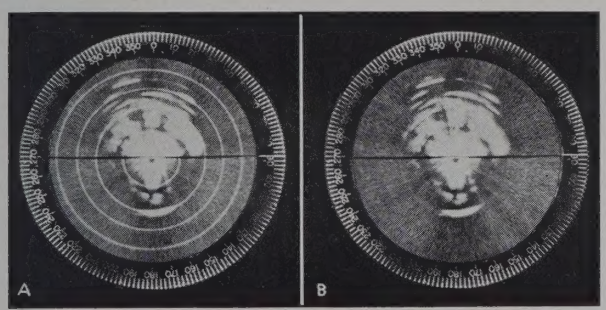


FIG. 6 — SIGNALS AS SEEN ON PPI SCREEN. (A) SIGNALS AND MARKERS; (B) SIGNALS.

(f) Set Antenna Switch N to either the "CW" (clockwise) or "CCW" (counterclockwise) position, and watch the PPI for luminous arcs which indicate signals (see Fig. 6A). (Do not confuse the signal arcs with the range marker circles.)

(g) If no signals are received, advance GAIN Control C toward maximum. If signals are still not received, turn back GAIN Control C to about three-quarters maximum and adjust TUNE Control H to vary the frequency of the local oscillator until signals are received. Then stop the Antenna on a target by means of Antenna Switch N, and carefully readjust TUNE Control H for brightest signals.

In the absence of actual targets, the Resonance Chamber (Echo Box) may be used in tuning the Receiver.

(h) Readjust GAIN Control C and MARKS Control D for the desired relative brightness of signals and markers.

(i) Adjust INT Control M for the desired over-all intensity.

(j) Readjust FOCUS Control O for sharpest signals.

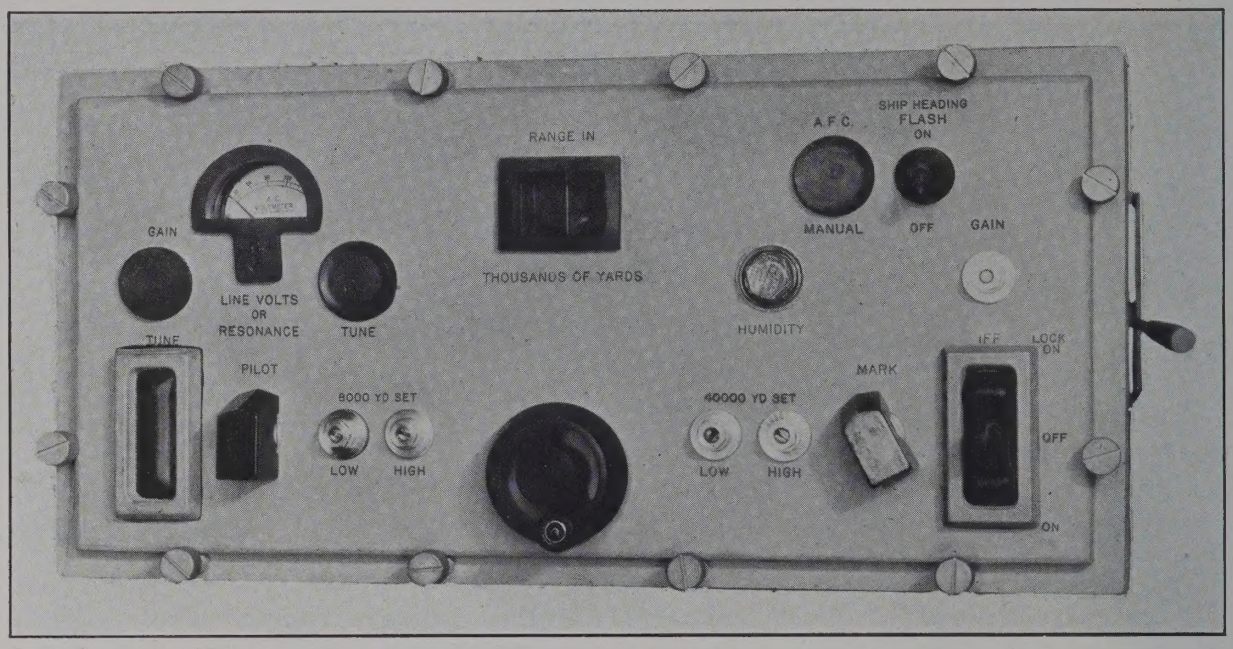


FIG. 7 — ACCESSORY CONTROL UNIT FOR S-BAND: FRONT PANEL.

3.2 DETERMINING RANGE

DETERMINING APPROXIMATE RANGE

(a) Place the range markers on the PPI screen by advancing MARKS Control D until the markers appear with the desired brilliancy.

The distance represented by these markers varies with the setting of Range Switch J. For example, using Indicator CRP-55ADQ, and with the Range Switch set on the 4-mile range position, markers are spaced at one-mile intervals; when set on the 20-mile range position, markers are spaced at 5-mile intervals; and when set on the 80-mile position, at 20-mile intervals. (See Fig. 6A.)

(b) Estimate the range of the target by reference to these markers, keeping in mind the marker intervals as determined by the setting of Range Switch J.

NOTE: The provided ranges and corresponding marker values for different types of Indicators are shown below. (The type of Indicator can be identified by noting the ranges provided on Range Switch J.) One radar mile equals 2000 yards.

Range	*Marker Interval*
INDICATORS CRP-55ACP/CRP-55ADS	
5	1 mile
20	4 miles
75	15 miles
INDICATOR CRP-55ADS-1 (LCC Conversion)	
6	1 mile
12	1 mile
75	15 miles
INDICATOR CRP-55ADQ	
4	1 mile
20	5 miles
80	20 miles
INDICATOR CRP-55ADQ-1 (LCC Conversion)	
6	1 mile
12	1 mile
80	20 miles

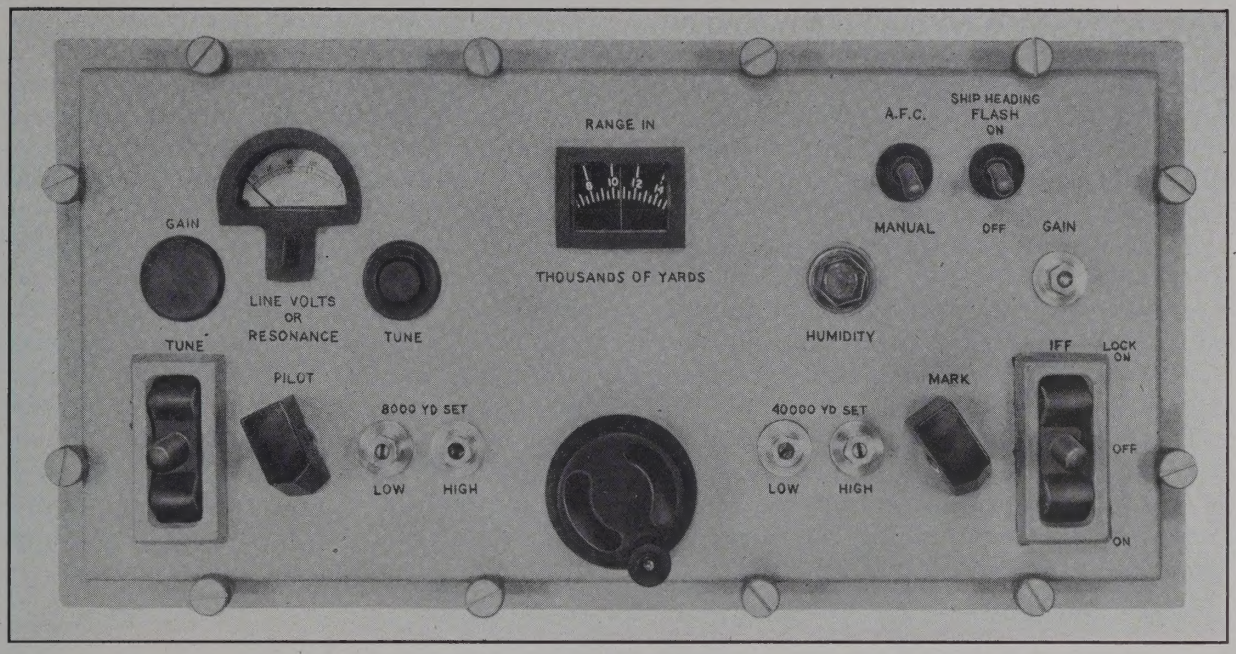


FIG. 8 — ACCESSORY CONTROL UNIT FOR X-BAND: FRONT PANEL.

DETERMINING ACCURATE RANGE

The Accessory Control Unit is required for this purpose. The controls are shown in Fig. 5 with numbers keyed to the text. (The A.C.U. is always on when the Radar is on.) It is assumed that the Accessory Control Unit is properly calibrated. If not, refer to Sec. 3.4.

(a) Advance MARK Control 11 (on A.C.U.) to about three-quarters maximum.

(b) Advance PILOT Control 6, which adjusts the illumination on Range Dial 14, until the dial is clearly visible.

(c) Rotate Range Crank 15 until the *movable range mark* exactly coincides with the desired signal.

(d) Read the range on Range Dial 14.

NOTE: This dial has two scales: a 40,000-yard scale for long ranges and an 8000-yard scale for short ranges. When Range Switch J (on the Indicator) is set either to the intermediate or to the shortest range position, the corresponding scale on Range Dial 14 is automatically illuminated and the other scale is dark.

DETERMINING SHIP'S HEADING (O.S.C.) WHEN USING TRUE BEARING

When the SO-Series Radar system uses a Bearing Control Unit (true-bearing kit) the ship's heading may be read directly from the PPI tube bearing dial. Throw the SHIP HEADING FLASH Switch 3 to "On." A bright line (flash) will appear on the tube radially at the bearing corresponding to the ship's true course. The line will flash once for each revolution of the PPI sweep. If the heading flash is not desired, throw the flasher switch to the "Off" position. When using relative bearing the flash occurs at 0° on the PPI tube at all times.

3.3 A.C.U. OPERATING CONTROLS

Range Crank 15 adjusts the position of the *movable range mark* on the PPI screen to coincide with the signal to be ranged. It is mechanically coupled to Range Dial 14. This dial indicates the accurate range of a target. It has two scales, one or the other of which is automatically illuminated when Range Switch J (on the Indicator) is set to the corresponding range position. PILOT Control 6 adjusts the illumination on Range Dial 14. MARK Control 11 adjusts the brilliance of the *movable range mark*.

LOW Control 7 and HIGH Control 8 ("8000 YD. SET") and LOW Control 9 and HIGH Control 10 ("40,000 YD. SET") are used to

calibrate the accurate range system in the A.C.U. to the Indicator.

Line Voltmeter 13 indicates the supply voltage of the Radar.

SHIP HEADING FLASH Switch 3 controls the flasher circuit which is provided when a true-bearing system is installed.

IFF Switch 12 (supplied) and GAIN Control 4 (not supplied) are both used to control external IFF equipment. IFF Switch 12 has three positions: "Lock On," a locking position; "Off"; and "On," a non-locking or keying position.

TUNE Button 2, TUNE Switch 5, and the A.F.C.–MANUAL Switch are used only with SO-Series Equipments operating on the X-band. In these equipments, the Resonance Chamber is remotely tuned by means of a small motor which may be rotated in either direction by means of TUNE Switch 5. While tuning, TUNE Button 2 should be depressed, connecting Line Voltmeter 13 to the resonance chamber amplifier. Correct tuning of the Resonance Chamber is shown by a marked dip in the meter reading. The A.F.C.–MANUAL Switch connects the automatic frequency control circuit. This circuit is explained in the instruction books for X-band equipments.

GAIN Control 1 was originally intended to adjust the indication of resonance chamber tuning appearing on Line Voltmeter 13. This adjustment has been found unnecessary and the control is not being supplied.

The HUMIDITY Indicator serves as a warning when the dehydrator plugs require replacement. It is omitted in later units.

3.4 CALIBRATING THE A.C.U.

The A.C.U. should not be calibrated until the equipment has been in operation for at least 30 minutes. The calibration should be checked every few hours.

The following procedure applies specifically to the calibration of the A.C.U. with Indicator CRP-55ADQ, which has 4-, 20-, and 80-mile ranges. The A.C.U. can be similarly calibrated with other types of Indicators having other ranges. In this case it will be necessary to use the correct range marker and to rotate Range Crank 15 until Range Dial 14 reads the correct number of yards for the range being calibrated. Marks and dial settings for each type of Indicator are shown in the following table. The rest of the procedure is unchanged.

CALIBRATING THE 4-MILE RANGE

(a) Set Antenna Switch N (on the Indicator) to "Off" and turn GAIN Control C to its counterclockwise limit.

(b) Advance MARKS Control D until small markers appear on the PPI screen. Adjust FOCUS Control O for maximum sharpness of these markers.

(c) With Range Switch J set on the 4-mile position, adjust SW-L (Sweep Length) Control F so that at least five markers (including the first or 0-mile marker) appear on the screen.

(d) Rotate Range Crank 15 until Range Dial 14 reads exactly 2000 yards. (2000 yards equals one Radar mile.)

A.C.U. Range Dial Settings For Various Indicators

Type of Indicator	*Setting of Range Switch J*	*Range Mark Used (Miles)*		*A.C.U. Range Used*	*Low Limit Set Point*	*High Limit Set Point*
		Low	*High*			
CRP-55ACP or	5	1	4	8,000	2,000	8,000
CRP-55ADS	20	4	20	40,000	8,000	40,000
CRP-55ADQ	4	1	4	8,000	2,000	8,000
	20	5	20	40,000	10,000	40,000
CRP-55ADS-1	6	1	4	8,000	2,000	8,000
	12	2	10	40,000	4,000	20,000
CRP-55ADQ-1	6	1	4	8,000	2,000	8,000
	12	2	10	40,000	4,000	20,000

(e) Adjust MARK Control 11 for proper brilliance of the *movable range mark*. This is best done when this mark and the PPI marks do not coincide.

(f) Adjust LOW Control 7 ("8000 YD. SET") until the mark and the one-mile range marker exactly coincide.

(g) Rotate the Range Crank until the Range Dial reads exactly 8000 yards, then adjust HIGH Control 8 ("8000 YD. SET") until the mark and the 4-mile marker coincide.

(h) Repeat steps (f) and (g) several times, since these two adjustments are reactive.

CALIBRATING THE 20-MILE RANGE

(a) Set Range Switch J to the 20-mile position, and rotate the Range Crank until the Range Dial reads exactly 10,000 yards.

(b) Adjust LOW Control 9 ("40,000 YD. SET") until the mark and the 5-mile range marker coincide.

(c) Rotate the Range Crank until the Range Dial reads 40,000 yards, then adjust HIGH Control 10 ("40,000 YD. SET") until the mark coincides with the 20-mile marker.

(d) Repeat steps (b) and (c) several times since the two adjustments are reactive.

The A.C.U. is now calibrated and ready for use in determining accurate ranges.

While the accurate ranging system may be used with Range Switch J on the 80-mile range, its use is limited to 20 miles since the mark will cover only the first quarter of the sweep.

3.5 LIST OF CONTROLS AND ADJUSTMENTS

Numbers in parentheses refer to numbers shown in the key photograph, Fig. 5.

Marking	*Symbol*	*Resistance (Max.) (Ohms)*	*Function*	*Location*
		Accessory Control Unit		
8000 YD. SET: LOW (7)	R-722	5,000	Aligns A.C.U. ranging to Indicator	Screwdriver adjustment on panel, lower left
40,000 YD. SET: LOW (9)	R-723	5,000	Aligns A.C.U. ranging to Indicator	Screwdriver adjustment on panel, lower right
8000 YD. SET: HIGH (8)	R-713	5,000	Aligns A.C.U. ranging to Indicator	Screwdriver adjustment on panel, lower left
40,000 YD. SET: HIGH (10)	R-714	5,000	Aligns A.C.U. ranging to Indicator	Screwdriver adjustment on panel, lower right
Range Crank (15)	R-707	20,000	Adjusts position of movable range mark	Hand crank on panel, lower center
MARK (11)	R-734	200 (dual)	Controls intensity of movable range mark	Knob on panel, lower right
PILOT (6)	R-744	50	Controls pilot light intensity	Knob on panel, lower left
GAIN (4) (Not supplied)	R-750		Controls IFF gain	Knob on panel, right center
IFF (12)	S-703		Switches IFF equipment	On panel, lower right
SHIP HEADING FLASH (3)	S-704		Controls ship heading flash	Toggle switch on panel, upper right
TUNE* (2)	S-701		Switches Meter M-702 from line voltage to echo box resonance indication	On panel, left center
TUNE* (5)	S-705		Controls tuning of echo box	On panel, lower left
A.F.C.–MANUAL*	S-706		Switches automatic frequency control	On panel, upper right

**Used only with Model SO-3, SO-4, and SO-12M Radars, and other SO-Series Equipments operating on the X-band.*

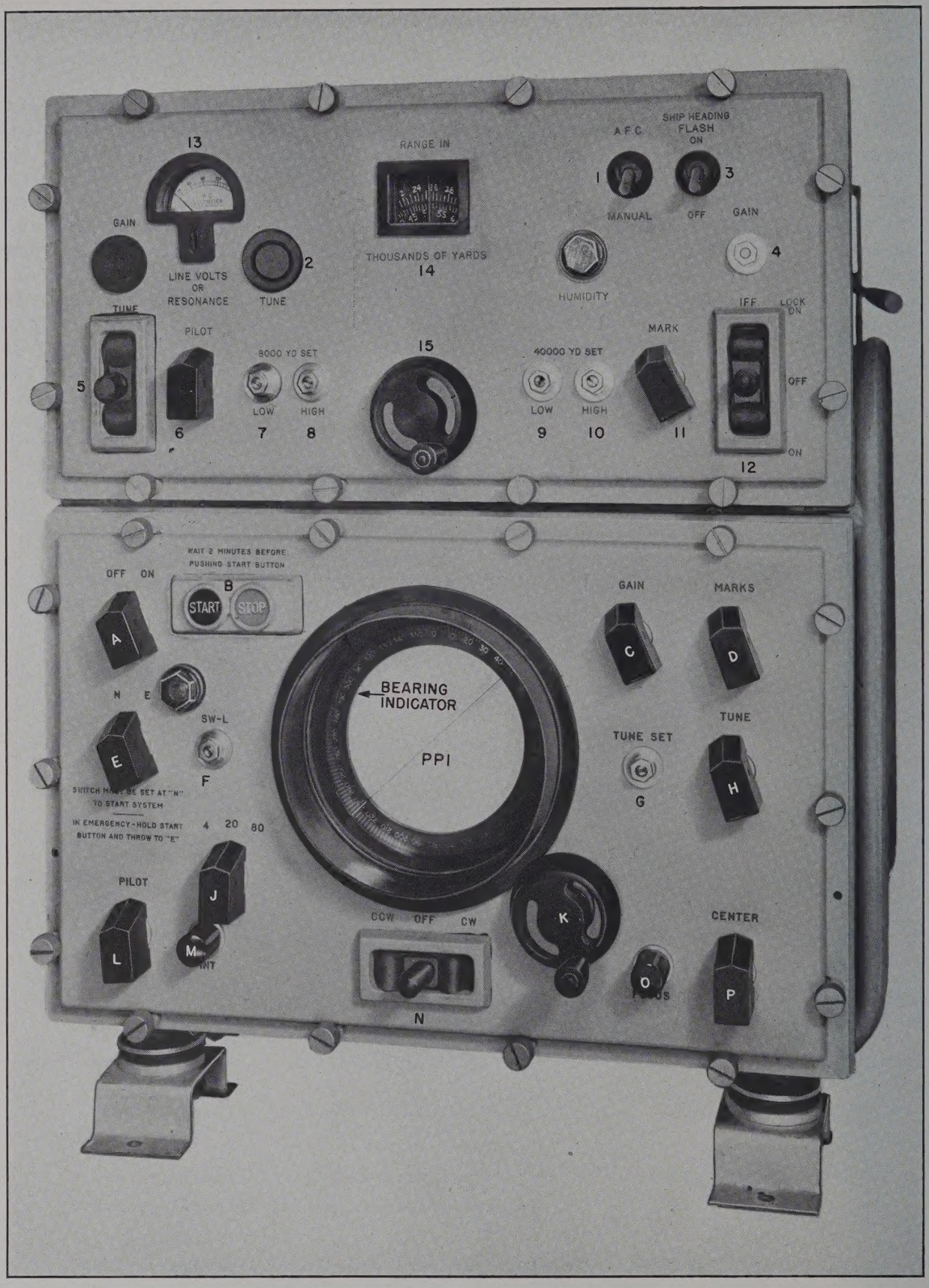


FIG. 9 — ACCESSORY CONTROL AND INDICATOR UNITS FOR X-BAND: CONTROL PANELS.

Section 4 — Theory of Operation

4.0 GENERAL

The chief function of the Accessory Control Unit is the generation, control, and calibration of the variable range mark which traces the "range ring" on the PPI screen. Functional operation has already been outlined under Sec. 1.0. The circuits are analyzed below.

4.1 LINEAR SAWTOOTH GENERATOR AND PICKOFF DIODE

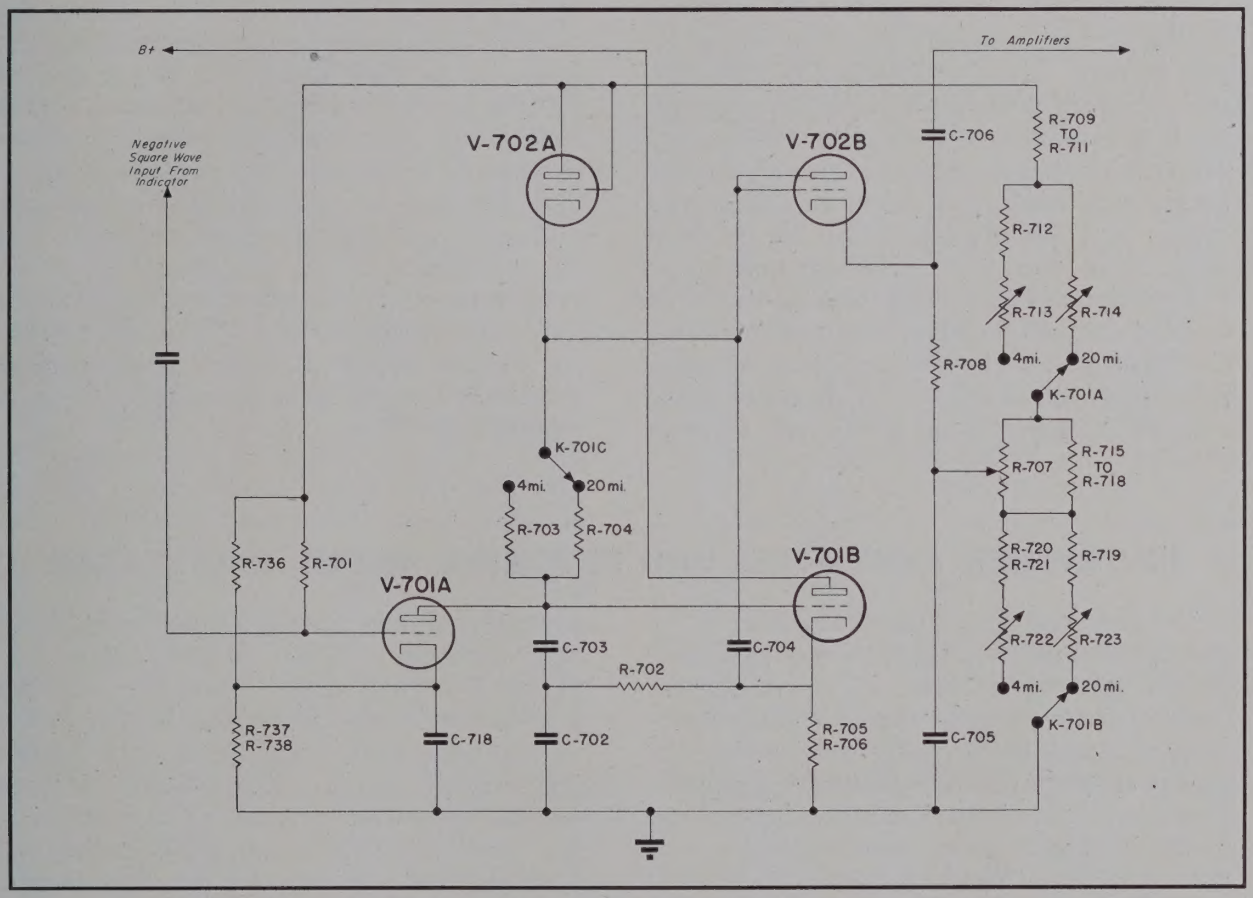


FIG. 10 — LINEAR SAWTOOTH GENERATOR AND PICKOFF DIODE.

Clamping tube V-701A normally conducts a small amount of current, due to the biasing network composed of R-701, R-736, R-737 and R-738. This establishes a potential at the plate of V-701A and across C-703 and C-702 which is considerably less than the regulated plate supply of 210 volts. This resting potential varies depending on the range in use, being approximately 50 volts on the low range and 25 volts on the intermediate range setting. The charging storage capacitor C-704 (driven by the cathode follower) has a charge of

approximately the difference between the voltage at the plate of V-701A and the plate supply impressed on it.

A negative square wave from the PPI multivibrator is applied to the grid of the clamper, biasing it to cutoff. This allows the linear sawtooth generator capacitors C-703 and C-702 to begin charging toward plate supply potential through the series resistance of V-702A (the isolating diode) and either R-703 or R-704. If the cathode follower were not contributing to the rate of charge of the sawtooth generating capacitors, they would charge in such a manner that the voltage appearing across them would rise as an exponential function of time. However, the voltage appearing across the sawtooth capacitors is also applied to the grid of the cathode follower V-701B and causes its cathode potential to increase at nearly the same rate as its grid voltage. This rising voltage is applied to the cathode of isolating diode V-702A through C-704 and causes this tube to cease conducting. The only remaining source of charging current for the sawtooth capacitors is then the initial charge on C-704 plus the added charge from the cathode follower as it is driven positive.

A portion of the cathode follower output is coupled through R-702 to sawtooth capacitor C-702 and adds to the charge supplied through R-703 or R-704 and C-703. This added increment of charging current is adjusted, through proper proportioning of the circuit constants, to offset the normal exponential decay of the charging current. As a result the voltage appearing across C-703 and C-702 during the time the square wave is applied to the clamper rises linearly with time.

This linear sawtooth voltage, which is rising in a positive direction, is applied to the plate of the pickoff diode V-702B. The cathode of the pickoff diode has a positive bias on it which varies with the setting of the range potentiometer R-707 and the limit sets R-713, R-714, R-722 and R-723. The range potentiometer is coupled to the range dial and hand crank. If the range of bias adjustment on the cathode of V-702B (through these controls) is made equal to the rise in voltage of the linear sawtooth during the time the square wave is applied to the clamper, then by setting the range potentiometer to the proper position the diode can be made to conduct at any desired delay in time. The range dial which is coupled to the range potentiometer can then be calibrated in terms of thousands of yards of delay.

At the time the pickoff diode conducts, the voltage at its cathode suddenly starts to rise in a positive direction. This changing voltage is applied to a circuit which responds readily only to a changing voltage. This "differentiating" circuit applies a sharply rising voltage similar to a square wave to the grid of trigger amplifier V-703.

4.2 TRIGGER AMPLIFIERS AND BLOCKING (MARK) OSCILLATOR

The plate current of trigger amplifier V-703 is coupled through a small pulse transformer to the grid of V-704A. The transformer characteristics are such that a voltage is developed across its windings only during the time that the current flow is changing rapidly. This condition exists at the beginning and end of the distorted square wave applied to the grid of V-703. The start of the wave applied to the grid of V-703 coincides in time with the conduction of the pickoff diode, and the end of the wave coincides with the removal of the square wave applied to the clamping tube V-701A.

The two sharp voltage pulses thus generated are applied to the grid of the second trigger amplifier V-704A which is in turn coupled through a similar transformer to the blocking mark oscillator V-704B. In addition the output of V-704B is coupled back through the transformer in such a way that it adds to the voltage pulse applied by V-704A. This highly regenerative circuit drives V-704B to plate current saturation within a fraction of a microsecond. This action coincides in time with the first pulse applied from the trigger amplifiers.

As soon as the plate current of V-704B reaches saturation, there is no voltage induced in the grid winding of the transformer T-705. The grid of the blocking oscillator then drops to a potential negative with respect to ground due to the charge stored on C-708 during the time grid current was flowing. This produces

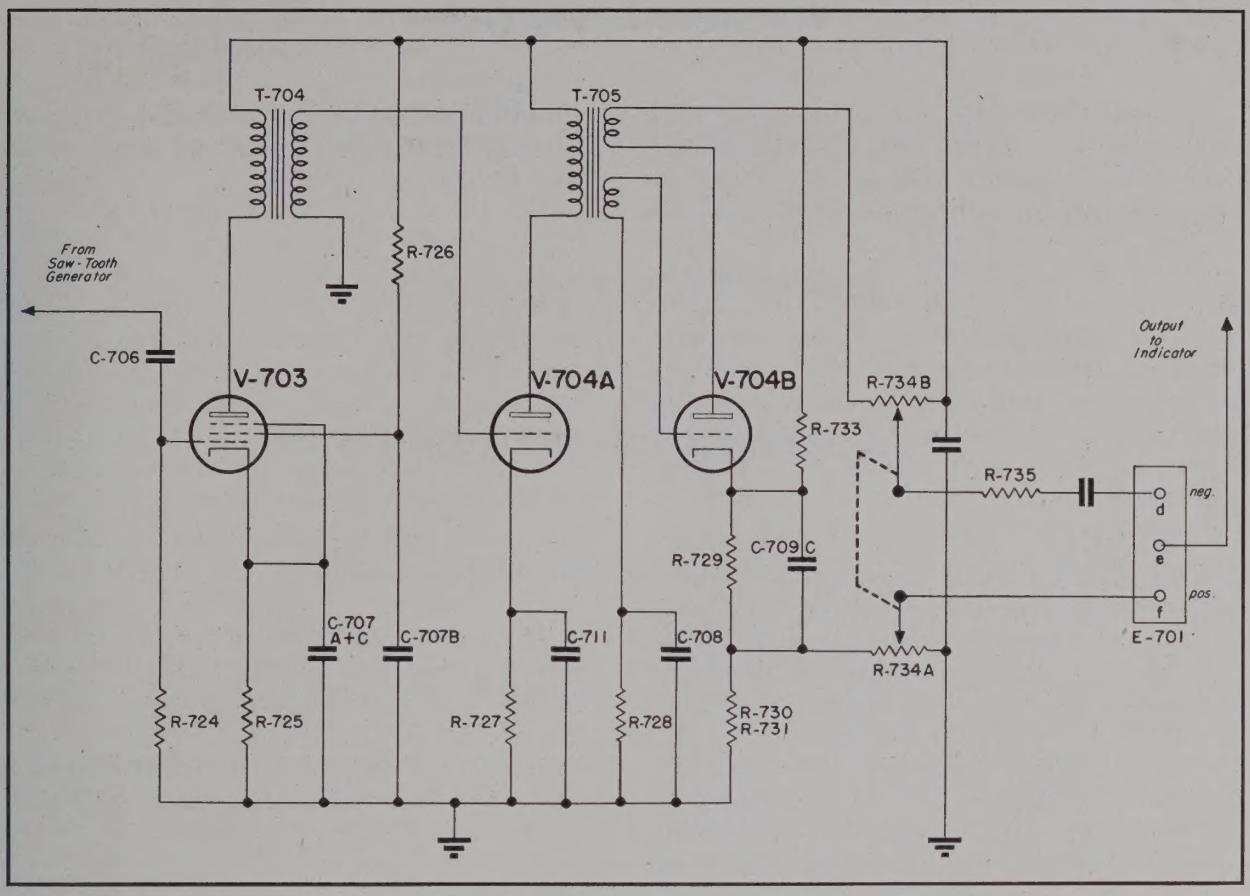


FIG. 11 — TRIGGER AMPLIFIERS AND BLOCKING OSCILLATOR.

a sudden decrease in plate current flow in V-704B which through transformer coupling drives its grid still farther negative. Plate current to the blocking oscillator is then shut off. Additional transients in the windings of T-705 are insufficient in value to again trigger the oscillator whose cathode is held above cutoff bias by the divider composed of R-729, R-730, R-731 and R-732. The negative bias on the grid capacitor C-708 leaks off through its shunt resistor before the next trigger pulse is applied.

The Mark Control R-734 is a dual 200-ohm potentiometer with one section connected in the plate current feed and the other section in the cathode current circuit. The very sharp pulse developed by the sudden change in plate current to V-704B appears across the plate resistor as a negative voltage and across the cathode resistor as a positive voltage. A portion of either of these outputs may be selected by proper positioning of the output connecting link on terminal strip E-701.

Because of the high value of the current pulse to the blocking oscillator it is necessary to use both decoupling and attenuating circuits in the plate circuit output, and to use a very low value of shunt resistor in the cathode output circuit. This results in a clean sharp mark at the time the pickoff diode conducts, and filters out all minor transients which might produce confusing results.

4.3 POWER SUPPLY

The power supply furnishes both regulated and unregulated B voltage as well as a.c. for the filaments and pilot lights.

The rectifier is a conventional one using a pi-section filter with capacitor input. Unregulated d.c. is taken from the output of the filter; regulated 210-volt d.c. is obtained from the same filter through a voltage regulator circuit employing two type VR105-30 tubes V-705 and V-706.

4.4 MINOR FUNCTIONS

In addition to the ranging system already described, the A.C.U. also contains several simple switches and controls which need no further explanation. The functions of these are given in the List of Controls and Adjustments on page 13; and their circuits are shown on the main schematic.

4.5 RESONANCE CHAMBER AMPLIFIER

On A.C.U.'s for X-Band (CRP-23AEE, 'AEG,'AFD) a small amplifier assembly is added in the left front corner of the chassis in place of a removable blind plate (see Fig. 2) to provide a means of tuning the Resonance Chamber which is independent of receiver tuning.

The amplifier comprises three cascaded resistance-coupled stages. The rectified pulse from the echo box crystal is applied to the input stage and appears at the last stage (grid) as a positive pulse whose duration and amplitude is maximum when the Echo Box is at resonance.

The flow of grid current develops an average negative bias in the last stage which reduces the plate current proportionally to the applied signal.

A meter connected in the current lead to this stage then indicates resonance by a minimum reading (dip).

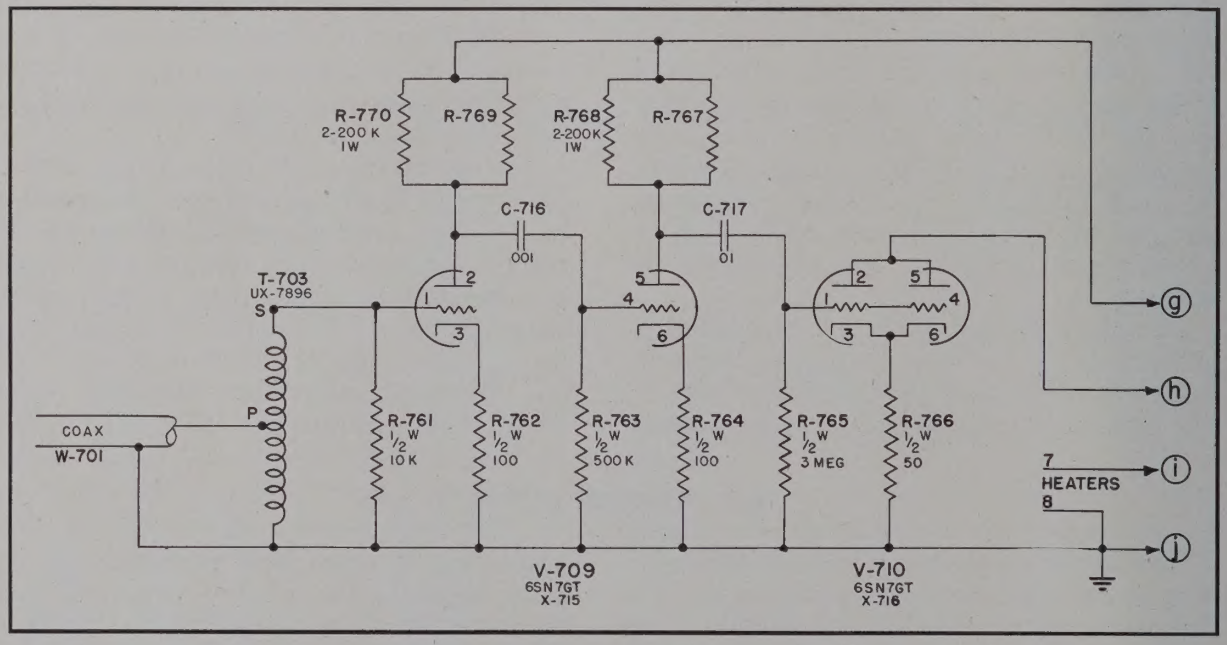


FIG. 12 — RESONANCE CHAMBER TUNING AMPLIFIER: SCHEMATIC (FOR ACCESSORY CONTROL UNIT CRP-23AEE, 'AEG, AND 'AFD).

Section 5 — Maintenance

5.1 PREVENTIVE MAINTENANCE

Preventive maintenance consists of periodic cleaning of the chassis and tightening of the leads. Dusting should be done by using dry compressed air and a clean dry cloth.

The range relay contacts should be burnished monthly with a regular point burnishing tool. The setscrews on the shaft coupling between the range dial and range potentiometer R-707 must be kept tight. The plugs and jacks on the chassis connector should be inspected monthly and cleaned and tightened when evidence of corrosion or looseness appears.

5.2 LOCATING TROUBLE

GENERAL

Faulty components can be traced in several ways, the most convenient being through voltage and resistance measurements.

The Table of Voltage Measurements (page 21) lists the socket voltages at all tubes. To isolate the trouble, measurements should be made and compared with the values given. In addition, the resistance of suspected parts may be taken and compared with values shown on the schematic. (The resistance values of the controls are given in the table on page 13.)

The Accessory Control Unit is so constructed that inter-unit cables are automatically disconnected when the chassis is withdrawn from the case. To permit checking the unit under operating conditions, a special test cable is included in spares. This is used to connect the chassis of the A.C.U., after removal, to the cable terminals in the case. A Servicing Block Diagram and a Table of Test Point Locations are provided for checking purposes and are intended to be used together. A Table of Fuse locations is also provided below:

MISCELLANEOUS SYMPTOMS OF FAILURE

Unsteady motion of the range ring when the hand crank is turned indicates slipping of the range potentiometer drive mechanism or coupling slippage between the potentiometer and the dial. Erratic and false range indications would also result from the latter trouble.

Jumping of the range ring when the crank is turned indicates a defective or dirty contact on the range potentiometer or bad contact in relay K-701. Excessive drift in calibration may be caused by a defective V-701 or V-702. It may also be caused by extreme fluctuations in line voltage.

The small plug in transformers T-704 and T-705 are critical in regard to electrical characteristics. Transformers which are satisfactory for use as T-704 may not function properly as T-705. If trouble is encountered in the circuit following V-704, try replacing T-705 with a new transformer.

FUSE LOCATIONS

Fuse	*Value (Amperes)*	*Location*	*Function*	*Test Point and Voltage (No voltage indicates open fuse)*
F-701	1	Right front above chassis	T-701, T-702, and a.c. line voltmeter	Terms. M and N on E-703: 115 volts a.c.
F-702	3	Center left above chassis	Automatic frequency and echo box motor	Terms. 77 and 40 on J-701: 24 volts d.c.
Spares		Right front above chassis near panel		

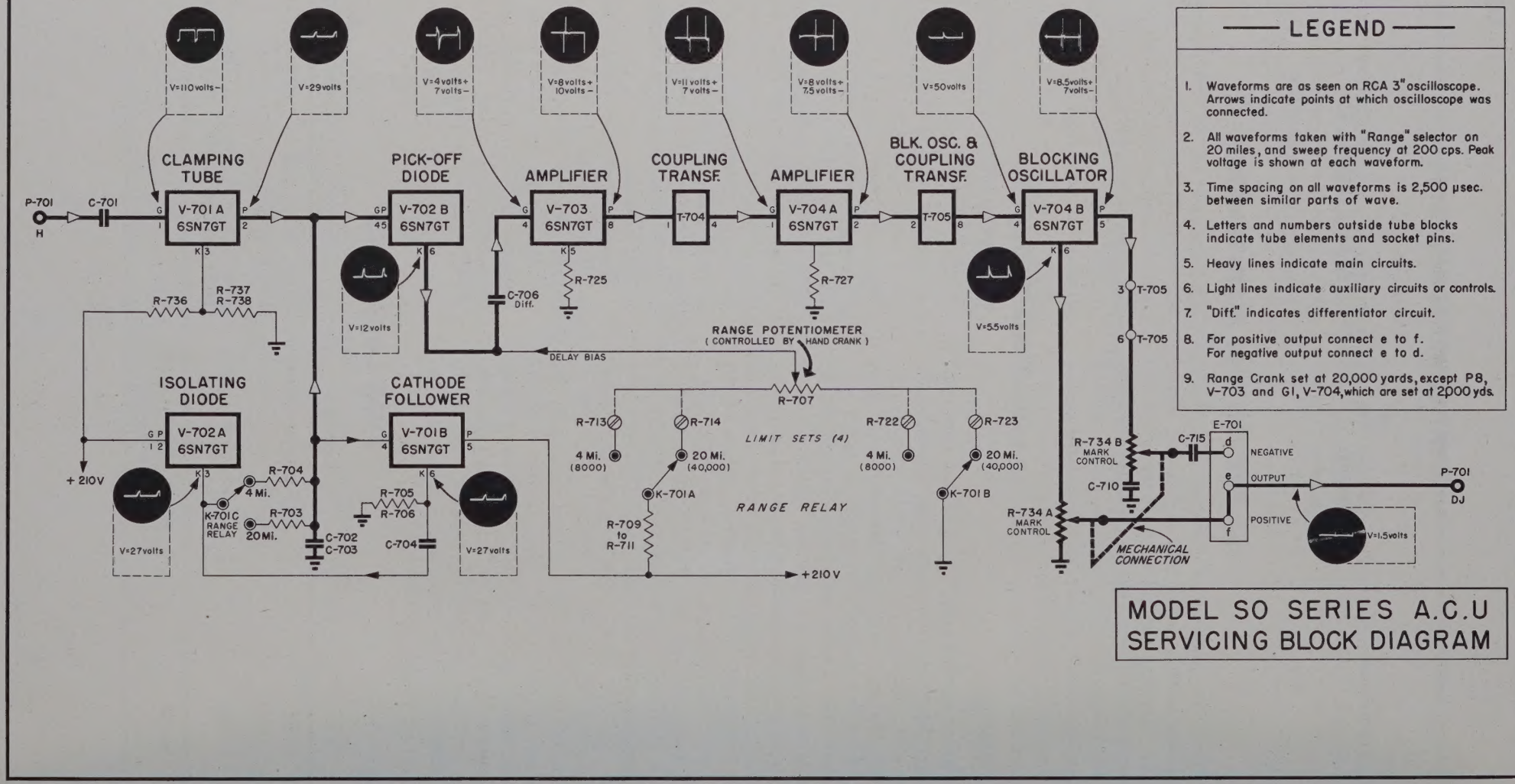


FIG. 13 — SERVICING BLOCK DIAGRAM.

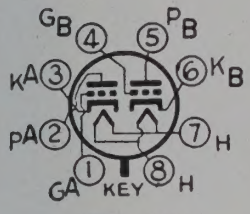
VOLTAGE MEASUREMENTS

Accessory Control Unit

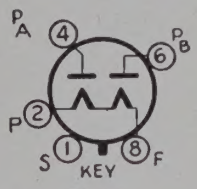
Measurements made from the designated terminals to ground using a 20,000-ohms-per-volt meter *and with the Transmitter not radiating*

Tube	*Type*	*Pin 1*	*Pin 2*	*Pin 3*	*Pin 4*	*Pin 5*	*Pin 6*	*Pin 7*	*Pin 8*
V-701	6SN7-GT	50	70	50	70	210	75	6.5	0
V-702	6SN7-GT	210	210	205	70	70	75	6.5	0
V-703	6AC7	0	0	0	0	1.6	13.5	6.5	210
V-704	6SN7-GT	0	210	0	0	205	15	6.5	0
V-705	VR105-30	—	105	—	—	210	—	—	—
V-706	VR105-30	—	0	—	—	105	—	—	—
V-707	5U4-G	—	360 d.c.	—	325 a.c.	—	325 a.c.	—	360 d.c.

NOTE: With normal 115-volt 400-cycle input, voltages may vary ± 10% from values shown. All voltages measured with the A.C.U. not triggered, all Limit Set Controls at counterclockwise limit, and Range Dial 14 at zero; and with Range Switch J (on the Indicator) set at 4 miles.



6SN7-GT



5U4-G

VR105-30

6AC7

5.3 SPECIFIC MAINTENANCE INSTRUCTIONS

REMOVAL OF CHASSIS

(a) Loosen the captive thumbscrews around the edge of the panel.

(b) Lift up the locking lever located on the right side of the case, and pull out the chassis.

(c) To service the chassis while operative, connect between J-701 and P-701 the indicator test cable found in spares.

REINSTALLATION OF CHASSIS

(a) First make sure that the locking lever is up, then slide the chassis into its case, until it strikes the latch.

(b) Press down the locking lever and secure the captive screws.

INSTALLATION OF NEW UNIT

When the old A.C.U. must be replaced, it is best to remove the terminal box enclosing J-701 from the old unit and install it (complete with cabling) on the new unit. All seals must be watertight.

REPLACEMENT OF TUBES

All tubes are secured in their sockets by locking devices which keep them firmly in place under shock and vibration. These locks must be released before the tubes are removed. Spare tubes will be found in equipment or tender spares.

DEHYDRATOR PLUGS

The dehydrator plugs ("Protek-Plugs") used in the unit will become exhausted after a time and must be replaced. This is done by unscrewing the exhausted plug and screwing a new plug into the mount.

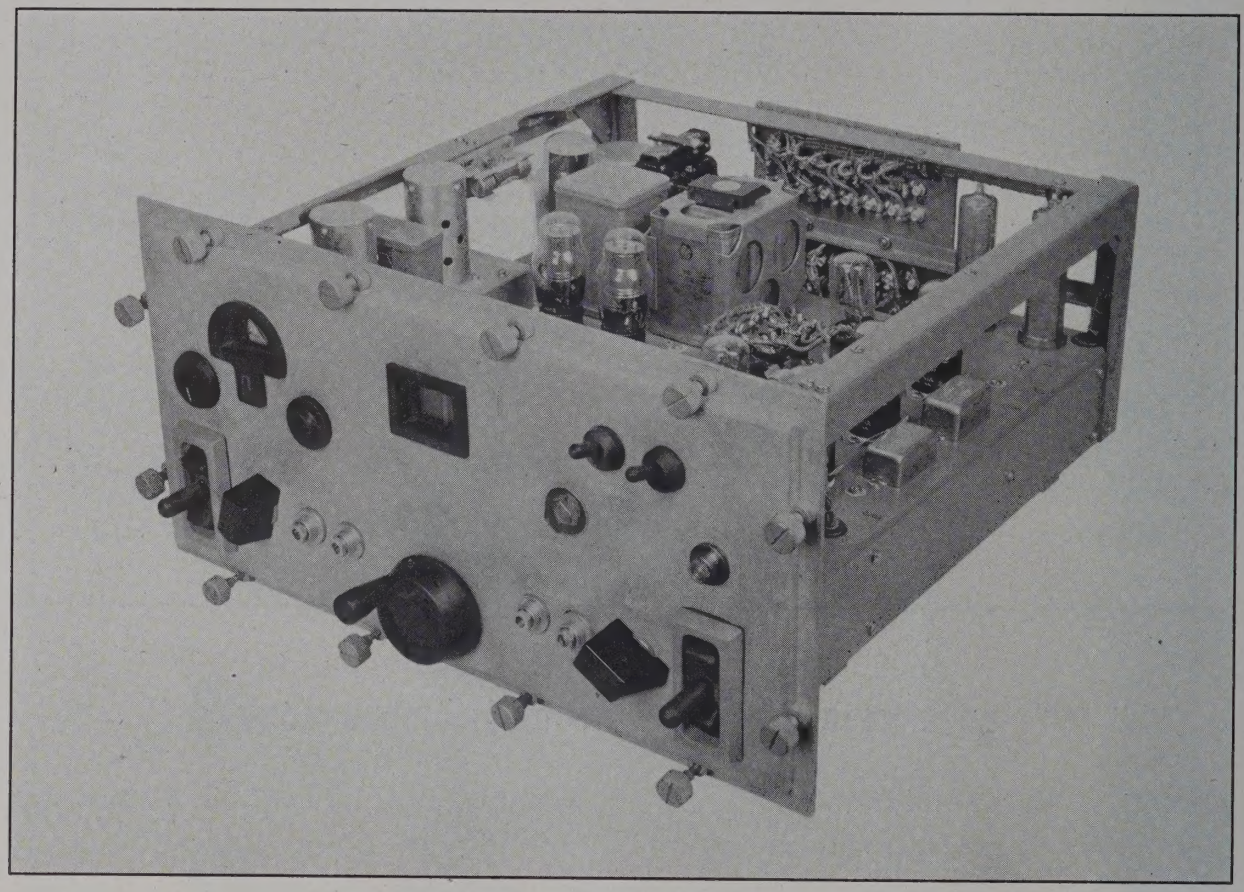


FIG. 14 — ACCESSORY CONTROL UNIT CRP-23AEE
(400-CYCLE MODEL WITH X-BAND CONTROLS): TOP FRONT VIEW.

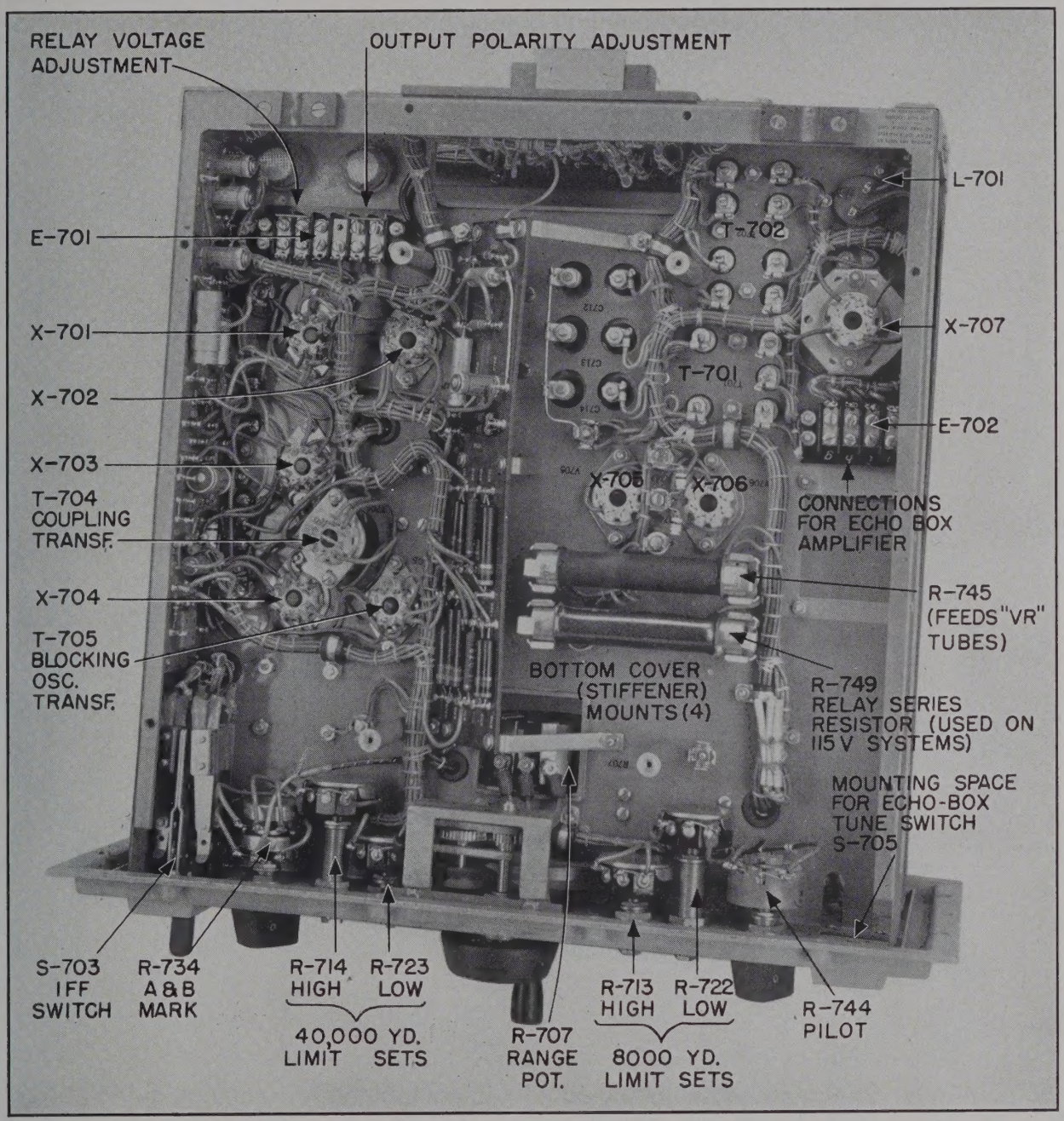


FIG. 15 — ACCESSORY CONTROL UNIT CRP-23ADZ: UNDERSIDE OF CHASSIS.

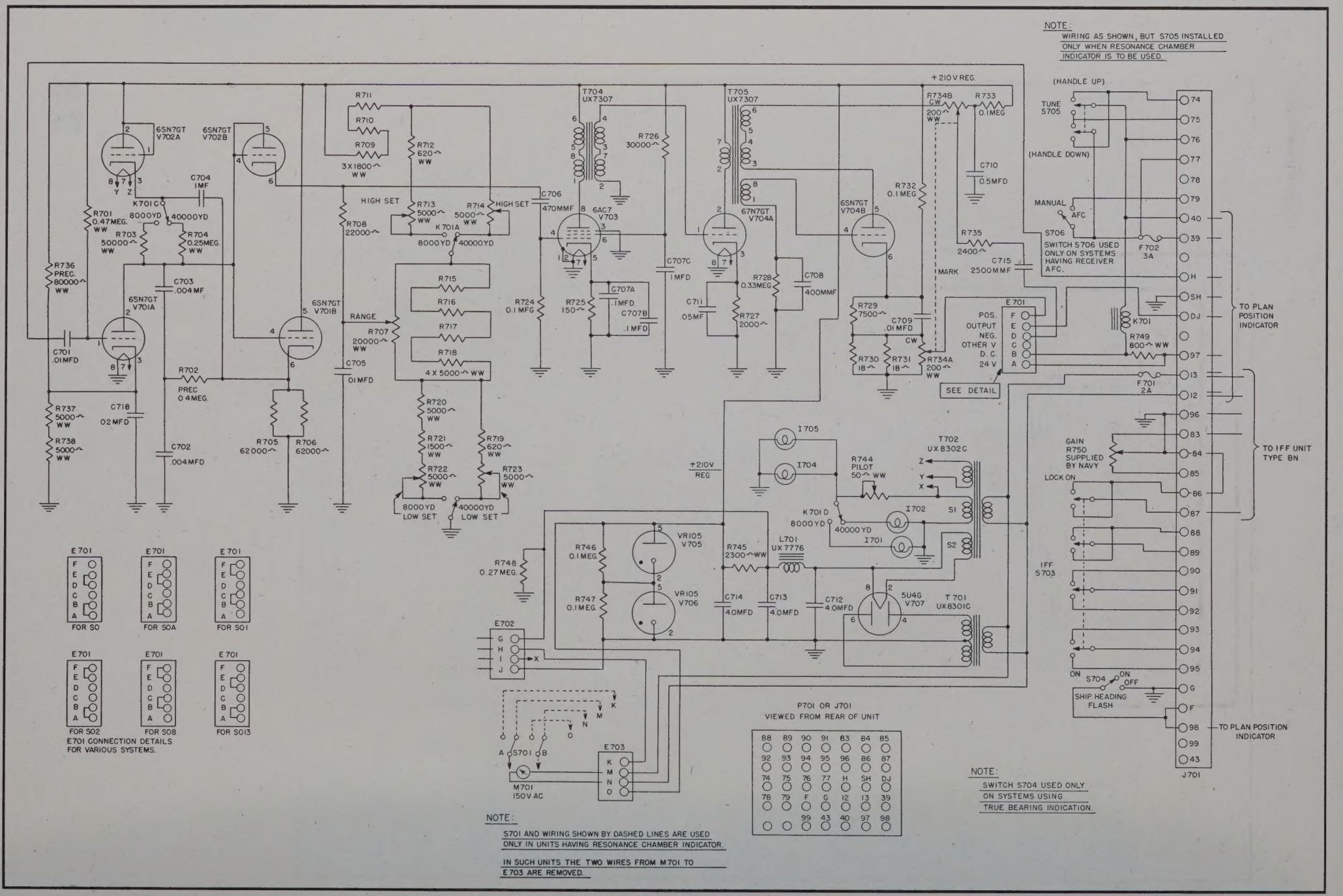


FIG. 16 — ACCESSORY CONTROL UNIT CRP-23ADZ: SCHEMATIC.
(Adapted from Drawing W-3K-260.)

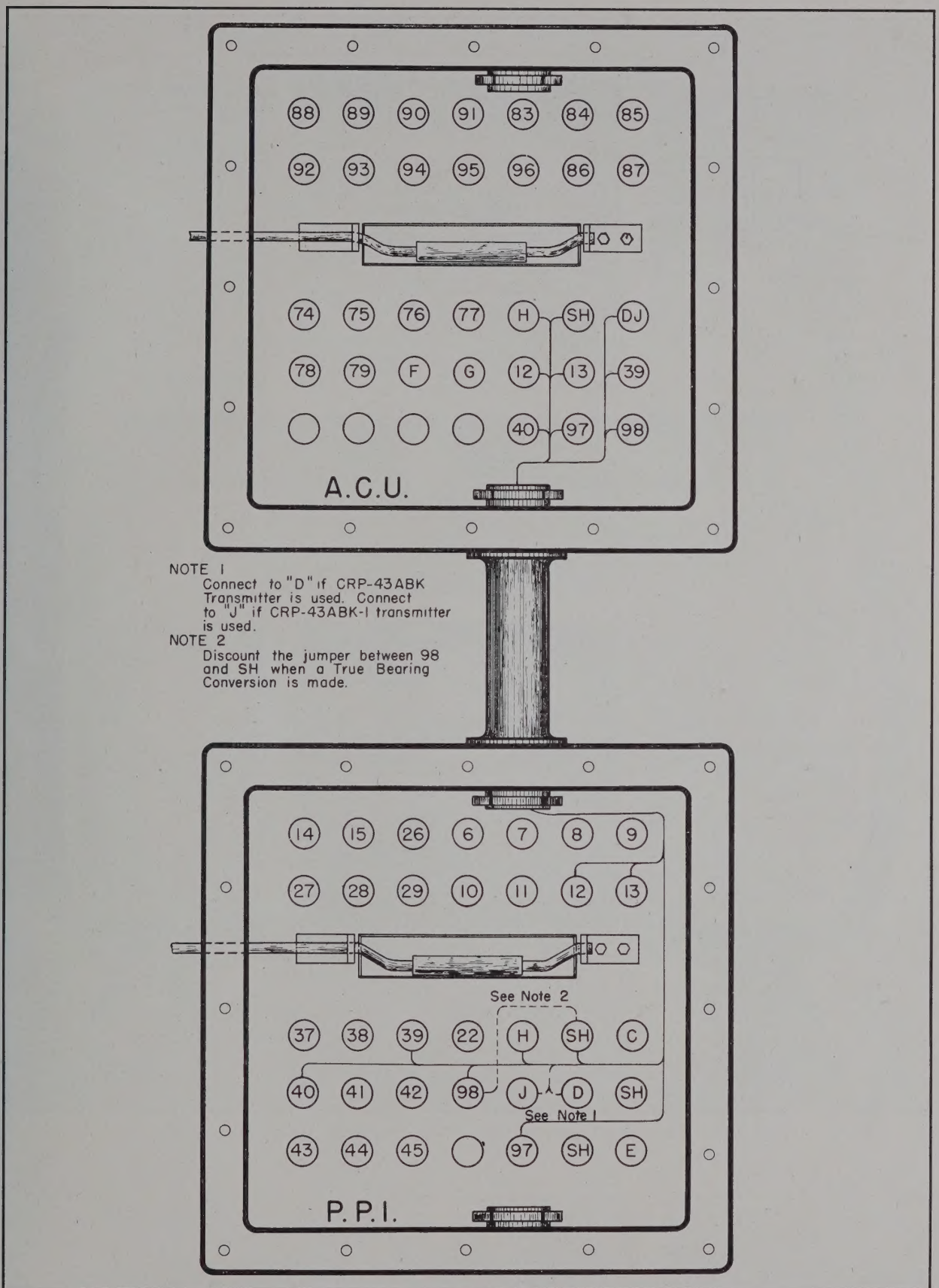

88 89 90 91 83 84 85
92 93 94 95 96 86 87
74 75 76 77 H SH DJ
78 79 F G 12 13 39
40 97 98
A.C.U.
NOTE 1
Connect to "D" if CRP-43ABK Transmitter is used. Connect to "J" if CRP-43ABK-1 transmitter is used.
NOTE 2
Discount the jumper between 98 and SH when a True Bearing Conversion is made.
14 15 26 6 7 8 9
27 28 29 10 11 12 13
See Note 2
37 38 39 22 H SH C
40 41 42 98 J D SH
See Note 1
43 44 45 97 SH E
P.P.I.

FIG. 17 — INTERCONNECTING CABLING: A.C.U. CRP-55ADZ AND INDICATOR CRP-55ADQ/'ADS

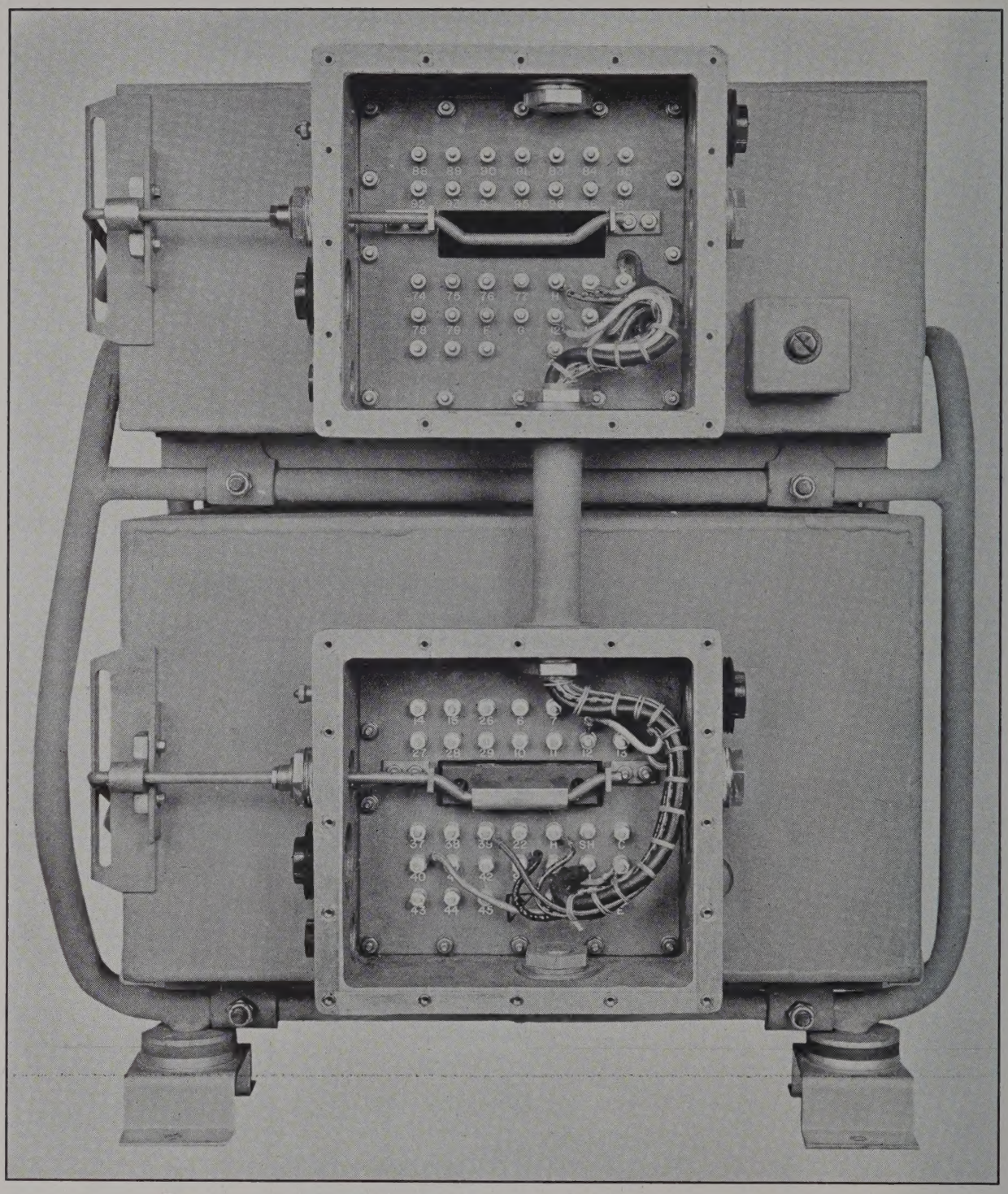


FIG. 18 — ACCESSORY CONTROL UNIT AND INDICATOR UNIT: REAR VIEW.

PARTS LIST

FOR

ACCESSORY CONTROL UNIT

FOR OPTIONAL USE WITH

SO-SERIES RADAR EQUIPMENT

RESTRICTED

TABLE I
LIST OF MAJOR UNITS FOR ACCURATE RANGE ACCESSORY KIT
RX-1028
FOR USE WITH MODELS SO, SO-a, SO-1, SO-2, SO-8 AND SO-13 RADAR EQUIPMENT

RESTRICTED

Navy Type Designation	Name of Major Unit	Symbol Group	Assembly Drawing Number
CRP-23ADZ	Accessory Control Unit	701 to 799	A-3K-X219
CRP-10252	Mounting Rack		A-3P1-X1

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TABLE II
PARTS AND SPARE PARTS LIST BY SYMBOL DESIGNATION FOR ACCURATE RANGE ACCESSORY KIT RX-1028
FOR USE WITH MODELS SO, SO-a, SO-1, SO-2, SO-8 AND SO-13 RADAR EQUIPMENT

Equipment Spares RX-1029
Tender Spares RX-1030
Stock Spares RX-1211

PART SPARES

SYMBOL DESIG.	FUNCTION	DESCRIPTION	NAVY TYPE NUMBER	NAVY DWG. OR SPEC. NUMBER	MFR.	MFR. DESIG.	CONTRACTORS DWG. AND PART NUMBER	TAG NO.	EQUIP. BOX NO.	EQUIP. QUANT.	TENDER BOX NO.	TENDER QUANT.	STOCK BOX NO.	STOCK QUANT.	ALL SYMBOL DESIGNATIONS INVOLVED
NAVY TYPE CRP-23ADZ ACCESSORY CONTROL UNIT															
		Accessory Control Unit	-23ADZ		28	WX-5238A		1501		0		0		1	
CAPACITORS															
C701	Input coupling capacitor	Capacitor, paper, .01 mfd., +20%-10%, 600 v dc wkg.		RE 13A 488D	33	PX-24A	35-5089	1510		2		5		8	C701, C705, C709
C702	Timing capacitor	Capacitor, silver mica, .004 mfd., ±1%, 500 v dc wkg.			32	MWSCW	35-5217	1511		1		2		2	C702, C703
C703	Timing capacitor	Same as C702								-		-		-	
C704	Sweep drive capacitor	Capacitor, paper, .1 mfd., +20%-10%, 600 v dc wkg.			33	PX-24A	35-5136	1513		1		2		3	C704
C705	Control voltage by-pass capacitor	Same as C701								-		-		-	
C706	Coupling capacitor	Capacitor, mica, .00047 mfd., ±10%, 500 v dc wkg.			32	MOCW	35-5221	1515		1		1		1	C706
C707A B C	V703 cathode by-pass capacitor V703 screen-grid by-pass capacitor V704 B plate decoupling capacitor	Capacitor, paper, 3 x .1 mfd., ±20%, 600 v dc wkg.	-48709-A		33	2529-4	35-5092	1516		1		2		3	C707
C708	V704B bias capacitor	Capacitor, mica, .00027 mfd., ±10%, 500 v dc wkg.			32	MOCW	35-5212	1517		1		1		1	C708
C709	V704B cathode by-pass capacitor	Same as C701								-		-		-	
C710	Output coupling capacitor	Capacitor, paper, 0.5 mfd., +20%-10%, 600 v dc wkg.	-48704-A	RE 48A 138C	33	2529-3	35-5093	1519		1		2		3	C710
C711	V704A cathode by-pass capacitor	Capacitor, paper, .05 mfd., +20%-10%, 600 v dc wkg.			33	PX-24A	35-5246	1520		1		2		3	C711
C712	Filter capacitor	Capacitor, paper, 4 mfd., ±10%, 600 v dc wkg.			33	2538-3	35-5094	1521		2		5		8	C712, C713, C714
C713	Filter capacitor	Same as C712								-		-		-	
C714	Filter capacitor	Same as C712								-		-		-	
C715	Negative output coupling capacitor	Capacitor, mica, .0025 mfd., ±10%, 500 v dc wkg.	-481089		30	C-1225-10	35-5142	1524		1		1		1	C715
C718	V701A cathode voltage divider by-pass capacitor	Capacitor, paper, .02 mfd., +20%-10%, 600 v dc wkg.			33	PX-24A	35-5090	1527		1		2		3	C718
TERMINAL STRIPS AND MISCELLANEOUS ELECTRICAL PARTS															
E701	Terminal strip for output polarity and relay coil voltage	Terminal strip, bakelite barrier type, 6 solder terminals with 6-32 x ¼" binder head screws			21	6-141-¼W	47-5043P3	1533		0		0		1	E701
E702	Terminal strip for resonance chamber indicator assembly connections	Terminal strip, bakelite barrier type, 4 solder terminals with 6-32 x ¼" binder head screws			21	4-141-¼W	47-5016P3	1534		0		0		1	E702
E703	Terminal strip for voltmeter	Terminal strip, bakelite barrier type, 4 solder terminals with 6-32 x ¼" binder head screws			21	4-141-W	47-5016P2	1535		0		0		1	E703

0 No spares furnished
- For spares see reference given in "Description" column

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TABLE II
PARTS AND SPARE PARTS LIST BY SYMBOL DESIGNATION
FOR ACCURATE RANGE ACCESSORY KIT
RX-1028
FOR USE WITH MODELS SO, SO-a, SO-1, SO-2, SO-8 AND SO-13 RADAR EQUIPMENT

Equipment Spares RX-1029
Tender Spares RX-1030
Stock Spares RX-1211

PART SPARES

SYMBOL DESIG.	FUNCTION	DESCRIPTION	NAVY TYPE NUMBER	NAVY DWG. OR SPEC. NUMBER	MFR.	MFR. DESIG.	CONTRACTORS DWG. AND PART NUMBER	TAG NO.	EQUIP. BOX NO.	EQUIP. QUANT.	TENDER BOX NO.	TENDER QUANT.	STOCK BOX NO.	STOCK QUANT.	ALL SYMBOL DESIGNATIONS INVOLVED
TERMINAL STRIPS AND MISCELLANEOUS ELECTRICAL PARTS (Cont'd)															
		Insulator, ceramic ½" long ½" dia. tapped 8-32, 3/16" deep at each end			40	1400	22-5047	1538		2		4		8	
		Insulator, ceramic, stand-off, conical ¼" long, tapped 6-32 at each end			48	GS-10	22-5012	1539		2		3		6	
FUSES															
F701	Main fuse for entire unit	Fuse, 1 a, 250 v, length 2" ferrule dia. 9/16"		17-F-2	57	25001	26-5035	1543		20		40		100	F701
F702	Motor fuse for Resonance Chamber Tuning	Fuse, 3 a, 250 v, length 2" ferrule dia. 9/16"		17-F-2	57	25003	26-5037	1544		10		20		50	F702
DIAL AND PILOT LIGHTS															
I701A	Dial light, range dial 8000 yd. range	Dial light, 6 volts, 1 cp.		TS-53	15	Mazda #51	77-5001	1550		8		16		24	I701A, I702A, I704A, I705A
I701B	Socket for I701A	Socket for dial light, bayonet type base			28		81-5038P2	1551		1		1		2	I701B, I702B
I702A	Dial light, range dial 40,000 yd. range	Same as I701A								-		-		-	
I702B	Socket for I702A	Same as I701B								-		-		-	
I704A	Meter illumination	Same as I701A								-		-		-	
I704B	Socket for I704A	Socket for dial light, bayonet type base			3	#1788	81-5040			*		*		*	I704B } For spares see Tag 1676 Page 6
I705A	Meter illumination	Same as I701A								-		-		-	
I705B	Socket for I705A	Socket for dial light, bayonet type base			3	#1787	81-5034			*		*		*	I705B }
RECEPTACLES															
J701	Accessory control input jack assy.	Jack panel assembly			28		3K26-192	1556		1		1		2	J701
J701A		Receptacle, jack, banana type			35	152347	51-5701G3	1557		2		4		8	J701A
CONTACTORS AND RELAYS															
K701	Range switching relay	Relay, 4 PDT, 24 v dc coil contacts rated 15 a.			75	BO-12D35	71-5023	1561		1		2		3	K701
INDUCTORS AND CHOKES															
L701	Filter choke	Reactor, 1.28 hy. min. ind. @ 130 ma dc and 3 v r.m.s. 60 ~ ac. Test 1200 v r.m.s. 1200½ turns #30E wire, 57 Ω max. dc res. Wt. 15 oz.		RE 13A 554D	28	UX-7776	92-403	1564		1		1		1	L701

\- For spares see reference given in "Description" column
* For spares see reference given in "All Symbols Designations" column

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PARTS AND SPARE PARTS LIST BY SYMBOL DESIGNATION
FOR ACCURATE RANGE ACCESSORY KIT RX-1028
FOR USE WITH MODELS SO, SO-a, SO-1, SO-2, SO-8 AND SO-13 RADAR EQUIPMENT

Equipment Spares RX-1029
Tender Spares RX-1030
Stock Spares RX-1211

PART									SPARES						
SYMBOL DESIG.	FUNCTION	DESCRIPTION	NAVY TYPE NUMBER	NAVY DWG. OR SPEC. NUMBER	MFR.	MFR. DESIG.	CONTRACTORS DWG. AND PART NUMBER	TAG NO.	EQUIP. BOX NO.	EQUIP. QUANT.	TENDER BOX NO.	TENDER QUANT.	STOCK BOX NO.	STOCK QUANT.	ALL SYMBOL DESIGNATIONS INVOLVED
		METERS													
M701	Meter line voltage	Voltmeter ac 300 to 600 ~ frequency, 0-150 v scale			28		45-5009	1567		0		0		1	M701
		PLUGS AND PROBES													
P701	Accessory Control input plug assy.	Plug panel assembly			28		JK27-193	1570		1		1		2	P701
P701A		Plug banana screw type and hardware			35	152381	51-5701G4	1571		2		4		8	P701A
		RESISTORS													
R701	V701A grid resistor	Resistor, composition, 470,000 Ω ±5%, 1 watt, pigtail terminals	-63291	RE 13A 340C	34	CM-1	80-5507	1575		1		2		3	R701
R702	Integrating resistor	Resistor, precision wirewound, 400,000 Ω ±1%, 1 watt		RE 13A 372J	115	Type SL	80-5863	1576		1		2		3	R702
R703	Timing resistor, 8000 yd. range	Resistor, precision, wirewound, 50,000 Ω ±2%, 1 watt		RE 13A 372J	115	Type SL	80-5865	1577		1		2		3	R703
R704	Timing resistor, 40,000 yd. range	Resistor, precision wirewound, 250,000 Ω ±1%, 1 watt		RE 13A 372J	115	Type SL	80-5862	1578		1		2		3	R704
R705	V701B cathode resistor	Resistor, composition, 62,000 Ω ±5%, 1 watt, pigtail terminals	-63291	RE 13A 340C	34	CM-1	80-5458	1579		1		3		5	R705, R706
R706	V701B cathode resistor	Same as R705	-63291							-		-		-	
R707	Control voltage potentiometer	Resistor, potentiometer, wirewound 20,000 Ω ±10%, 6 watts, linear taper, shaft 19/32" long		RE 13A 492C	83	314A	40-5040P1			*		*		*	R707 For spares see Tag 1684 Page 7
R708	Control voltage filter resistor	Resistor, composition, 22,000 Ω ±10%, ½ watt, pigtail terminals	-63360	RE 13A 340C	34	MB-½	80-5425	1582		1		2		3	R708
R709	Part of control voltage divider	Resistor, wirewound, 1800 Ω ±5%, 2 watt, pigtail terminals		RE 13A 372J	20	BW-2	80-5876	1583		2		5		8	R709, R710, R711
R710	Part of control voltage divider	Same as R709								-		-		-	
R711	Part of control voltage divider	Same as R709								-		-		-	
R712	Part of 8000 yd. control voltage divider	Resistor, wirewound, 620 Ω ±5%, 1 watt, pigtail terminals	-63703-5	RE 13A 372J	20	BW-1	80-5407	1586		1		3		5	R712, R719
R713	8000 yd. high set	Resistor potentiometer, wirewound, 5000 Ω ±10%, 3 watts, linear taper, special shaft 11/16" long		RE 13A 492C	8	P58W	40-5039P1	1587		1		6		10	R713, R723
R714	40,000 yd. high set	Resistor, potentiometer, wirewound, 5000 Ω ±10%, 3 watts, linear taper special shaft 1-7/8" long		RE 13A 492C	8	P58W	40-5039P3	1588		1		6		10	R714, R722
R715	Part of control voltage divider	Resistor, wirewound, 5000 Ω ±5%, 1 watt, pigtail terminals	-63703-5	RE 13A 372J	20	BW-1	80-5287	1589		3		9		15	R715, R716, R717, R718, R737, R738
R716	Part of control voltage divider	Same as R715	-63703-5							-		-		-	
R717	Part of control voltage divider	Same as R715	-63703-5							-		-		-	

0 No spares furnished
- For spares see reference given in "Description" column
* For spares see reference given in "All Symbols Designations" column

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TABLE II
PARTS AND SPARE PARTS LIST BY SYMBOL DESIGNATION
FOR ACCURATE RANGE ACCESSORY KIT
RX-1028
FOR USE WITH MODELS SO, SO-a, SO-1, SO-2, SO-8 AND SO-13 RADAR EQUIPMENT

Equipment Spares RX-1029
Tender Spares RX-1030
Stock Spares RX-1211

PART SPARES

SYMBOL DESIG.	FUNCTION	DESCRIPTION	NAVY TYPE NUMBER	NAVY DWG. OR SPEC. NUMBER	MFR.	MFR. DESIG.	CONTRACTORS DWG. AND PART NUMBER	TAG NO.	EQUIP. BOX NO.	EQUIP. QUANT.	TENDER BOX NO.	TENDER QUANT.	STOCK BOX NO.	STOCK QUANT.	ALL SYMBOL DESIGNATIONS INVOLVED
		RESISTORS (Cont'd)													
R718	Part of control voltade divider	Same as R715	-63703-5							-		-		-	
R719	Part of 40,000 yd. control voltage divider	Same as R712	-63703-5							-		-		-	
R720	Part of 8000 yd. control voltage divider	Resistor, wirewound, 5000 Ω ±5%, 2 watts, pigtail terminals	-63705-5	RE 13A 372J	20	BW-2	80-5337	1594		1		2		3	R720
R721	Part of 40,000 yd. control voltage divider	Resistor, wirewound, 1500 Ω ±5%, 1 watt pigtail terminals	-63703-5	RE 13A 372J	20	BW-1	80-5288	1595		1		2		3	R721
R722	8000 yd. low set	Same as R714								-		-		-	
R723	40,000 yd. low set	Same as R713								-		-		-	
R724	V703 grid resistor	Resistor, composition, 100,000 Ω ±10%, ½ watt, pigtail terminals	-63360	RE 13A	34	MB-½	80-5235	1597		1		2		3	R724, R733
R725	V703 cathode resistor	Resistor, composition, 150 Ω ±10%, ½ watt, pigtail terminals	-63360	RE 13A 340C	34	MB-½	80-5351	1598		1		2		3	R725
R726	V703 screen-grid resistor	Resistor, composition, 30,000 Ω ±10%, 1 watt, pigtail terminals	-63288	RE 13A 340C	34	CM-1	80-5228	1599		1		2		3	R726
R727	V704A cathode resistor	Resistor, composition, 2000 Ω ±10%, ½ watt, pigtail terminals	-63360	RE 13A 340C	34	MB-½	80-5211	1600		1		2		3	R727
R728	V704B bias resistor	Resistor, composition, 330,000 Ω ±10%, ½ watt, pigtail terminals	-63360	RE 13A 340C	34	MB-½	80-5438	1601		1		2		3	R728
R729	V704B cathode resistor	Resistor, composition, 7500 Ω ±5%, ½ watt, pigtail terminals	-63355	RE 13A 340C	34	MB-½	80-5424	1602		1		2		3	R729
R730	V704B cathode resistor for positive output	Resistor, composition, 18 Ω ±5%, ½ watt, pigtail terminals	-63355	RE 13A 340C	34	MB-½	80-5602	1603		1		3		5	R730, R731
R731	V704B cathode resistor for positive output	Same as R730	-63355							-		-		-	
R732	V704B cathode voltage divider resistor	Resistor, composition, 100,000 Ω ±5%, 1 watt, pigtail terminals	-63291	RE 13A 340C	34	CM-1	80-5301	1605		1		2		3	R732
R733	V704B plate decoupling resistor	Same as R724	-63360							-		-		-	
R734	Marker output control	Resistor, dual potentiometer, each section 200 Ω ±5%, 2 watt, linear taper, special shaft		RE 13A 492C	20	Type W	40-5115P1	1607		1		3		5	R734
R735	Negative output attenuating resistor	Resistor, composition, 2400 Ω ±5%, ½ watt, pigtail terminals	-63355	RE 13A 340C	34	MB-½	80-5521	1608		1		2		3	R735
R736	Part of V701A cathode voltage divider	Resistor, precision wirewound, 80,000 Ω ±2%, 1 watt		RE 13A 372J	115	Type SL	80-6027	1609		1		2		3	R736
R737	Part of V701A cathode voltage divider	Same as R715	-63703-5							-		-		-	
R738	Part of V701A cathode voltage divider	Same as R715	-63703-5							-		-		-	
R744	Dial light intensity control	Resistor, potentiometer, wirewound, 50 Ω ±10%, 25 watts, linear taper special shaft		RE 13A 492C	8	PW-25-50	40-5048	1616		1		3		5	R744

- For spares see reference given in "Description" column

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TABLE II
PARTS AND SPARE PARTS LIST BY SYMBOL DESIGNATION
FOR ACCURATE RANGE ACCESSORY KIT
RX-1028
FOR USE WITH MODELS SO, SO-a, SO-1, SO-2, SO-8 AND SO-13 RADAR EQUIPMENT

Equipment Spares RX-1029
Tender Spares RX-1030
Stock Spares RX-1211

PART								SPARES						
								EQUIP.		TENDER		STOCK		
SYMBOL DESIG.	FUNCTION	DESCRIPTION	NAVY TYPE NUMBER	NAVY DWG. OR SPEC. NUMBER	MFR.	MFR. DESIG.	CONTRACTORS DWG. AND PART NUMBER	TAG NO.	BOX NO.	QUANT.	BOX NO.	QUANT.	BOX NO.	QUANT.	ALL SYMBOL DESIGNATIONS INVOLVED
		RESISTORS (Cont'd)													
R745	Dropping resistor for V705 and V706	Resistor, wirewound, 2300 Ω ±5%, Style D, Grade 1, Class II	-632032E	RE 13A 372J			80-6028	1617		1		2		3	R745
R746	Equalizing resistor for V705 and V706	Resistor, composition, 100,000 Ω ±5%, ½ watt, pigtail terminals	-63355	RE 13A 340C	34	MB-½	80-5295	1618		1		3		5	R746, R747
R747	Equalizing resistor for V705 and V706	Same as R746	-63355							-		-		-	
R748	Bleeder resistor	Resistor, composition, 270,000 Ω ±10%, 1 watt, pigtail terminals	-63288	RE 13A 340C	34	CM-1	80-5503	1620		1		2		3	R748
R749	Dropping resistor for 24 v relay (when used on 115 v)	Resistor, wirewound, 800 Ω ±5%, Style D, Grade 1, Class II	-63074-E	RE 13A 372J	33		80-5298	1621		1		2		3	R749
		SWITCHES, INTERLOCKS AND THERMOSTATS													
S703	IFF switch	Switch, lever type 4 PDT 3 position, center open			36		28-5079P2	1642		1		1		1	S703
S704	Relative bearing on-off switch	Switch, toggle type SPST current rated for 6 a 250 v			4	#80607	28-5086	1643		1		1		2	S704, S706
S706	A.F.C. relay switch	Same as S704								-		-		-	
		TRANSFORMERS													
T701	Plate supply voltage transformer	Transformer, Plate: Pri. 115/400/1φ Wind. / No. Turns / Wire Size / DC Res. / Volts / Amps. / Test V r.m.s. Pri. 208 24E 2.6 115 .48 1780 Sec. #1 1150 29E 60 600 .175 1780 Pri. rated: 55 va (approx.) Elec. shield Sec. CT. Wt. 1 lb., 8 oz.		RE 13A 554D	28	UX-8301C	92-340G1	1647		1		2		3	T701
T702	Filament transformer	Transformer, Filament: Pri. 115/400/1φ Wind. / No. Turns / Wire Size / DC Res. / Volts / Amps. / Test V r.m.s. Pri. #1 600 27E 9 115 .46 1780 Pri. #2 600 27E 9 115 .46 1780 Sec. #1 35 14E .039 6.3 4.7 1780 Sec. #2 28 16E .047 5.0 3.0 1780 Sec. #3 35 23E .30 6.3 1.3 1780 Pri. rated: 52.8 va (approx.) Elec. shield Wt. 1 lb., 9 oz.		RE 13A 554D	28	UX-8302C	92-341G1	1648		1		2		3	T702
T704	Coupling transformer	Transformer: Wind. / No. Turns / Wire Size / DC Res. A 50 36E 1.75 B 50 36E 1.9 C 50 36E 2.05			28	UX-7307	92-514S	1650		1		4		6	T704, T705

- For spares see reference given in "Description" column

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TABLE II
PARTS AND SPARE PARTS LIST BY SYMBOL DESIGNATION
FOR ACCURATE RANGE ACCESSORY KIT
RX-1028
FOR USE WITH MODELS SO, SO-a, SO-1, SO-2, SO-8 AND SO-13 RADAR EQUIPMENT

Equipment Spares RX-1029
Tender Spares RX-1030
Stock Spares RX-1211

PART									SPARES						
									EQUIP.		TENDER		STOCK		
SYMBOL DESIG.	FUNCTION	DESCRIPTION	NAVY TYPE NUMBER	NAVY DWG. OR SPEC. NUMBER	MFR.	MFR. DESIG.	CONTRACTORS DWG. AND PART NUMBER	TAG NO.	BOX NO.	QUANT.	BOX NO.	QUANT.	BOX NO.	QUANT.	ALL SYMBOL DESIGNATIONS INVOLVED
		TRANSFORMERS (Cont'd)													
T705	Coupling and blocking oscillator transformer	Same as T704								-		-		-	
		* VACUUM AND GASEOUS DISCHARGE TUBES													
V701	Clamper and cathode follower	Twin triode, low Mu amplifier	6SN7-GT		29	6SN7-GT	90-5051			6		9		0	V701, V702, V704
V702	Isolating diode and pick-off diode	Same as V701	6SN7-GT							-		-		-	
V703	Amplifier	Television, amp. pentode	6AC7		29	6AC7/1852	90-5072			2		3		0	V703
V704	Amplifier and blocking oscillator	Same as V701	6SN7-GT							-		-		-	
V705	Voltage regulator "B" supply	Voltage regulator	-38205		29	(VR105-30)	90-5058			4		6		0	V705, V706
V706	Voltage regulator "B" supply	Same as V705	-38205							-		-		-	
V707	Rectifier	Full wave rectifier	5U4-G		29	5U4-G	90-5056			2		3		0	V707
		SOCKETS AND FUSE HOLDERS													
X701	Socket for V701	Vacuum tube socket, 8 contacts, ceramic wafer, silvered contacts and mounting			2	RSS-8M	82-5012P3	1654		5		5		9	X701, X702, X703, X704, X705, X706, X707, X708, X709
X702	Socket for V702	Same as X701								-		-		-	
X703	Socket for V703	Same as X701								-		-		-	
X704	Socket for V704	Same as X701								-		-		-	
X705	Socket for V705	Same as X701								-		-		-	
X706	Socket for V706	Same as X701								-		-		-	
X707	Socket for V707	Same as X701								-		-		-	
X708	Socket for T704	Same as X701								-		-		-	
X709	Socket for T705	Same as X701								-		-		-	
		MECHANICAL SPARES													
		Spacer (cork)					3K1-134P1	1672		1		2		4	
		Window, meter					3K1-27P1	1674		0		1		2	
		Window, range					3K1-30P1	1675		0		1		2	
		Meter light assembly					3K23-175	1676		1		1		1	
		Block, meter					3K1-26P1	1677		0		1		1	
		Driver, dial					3K6-68P1	1678		0		1		1	
		Vane holder assembly					3K1-35	1680		0		1		2	
		Dial drive gear assembly					3K6-7	1681		0		1		2	

0 No spares furnished
- For spares see reference given in "Description" column
* Shipped in wooden packing cases - See Packing List

Revised 6-13-44

RESTRICTED

TABLE II
PARTS AND SPARE PARTS LIST BY SYMBOL DESIGNATION
FOR ACCURATE RANGE ACCESSORY KIT
RX-1028
FOR USE WITH MODELS SO, SO-a, SO-1, SO-2, SO-8 AND SO-13 RADAR EQUIPMENT

Equipment Spares RX-1029
Tender Spares RX-1030
Stock Spares RX-1211

PART SPARES

SYMBOL DESIG.	FUNCTION	DESCRIPTION	NAVY TYPE NUMBER	NAVY DWG. OR SPEC. NUMBER	MFR.	MFR. DESIG.	CONTRACTORS DWG. AND PART NUMBER	TAG NO.	EQUIP. BOX NO.	EQUIP. QUANT.	TENDER BOX NO.	TENDER QUANT.	STOCK BOX NO.	STOCK QUANT.	ALL SYMBOL DESIGNATIONS INVOLVED
		MECHANICAL SPARES (Cont'd)													
		Rubber stop					3K7-74P1	1682		1		2		4	
		Dial support assembly					3K5-6	1684		1		3		5	
		Gasket, pilot light					3K1-20P1	1686		1		2		4	
		Gasket, meter					3K1-28P1	1687		1		2		4	
		Gasket, range window					3K1-37P1	1688		1		2		4	
		Gasket, front panel					3K1-38P1	1689		1		2		4	
		Gasket, meter window					3K1-50P1	1690		1		2		4	
		Gasket, coax terminal box					3K3-81P1	1691		1		2		4	
		Gasket, cable pipe					3K3-85P1	1692		6		12		16	
		Grommet					3K2-117P1	1693		5		10		20	
		Grommet					3K2-118P1	1694		3		6		12	
		Mounting bushing assembly					3K29-195	1696		0		1		2	
		Captive screw					3C7-382P1	1698		0		0		12	
		Rubber gauntlet					3C7-220P1	1701		1		2		4	
		Lever bar handle			28		3C5-260P1	1702		0		1		1	
		Shock mount			91		39-5053P1	1703		1		4		8	
		Slider foot			28		3C6-124P1	1705		0		0		2	
		Air valve assembly			28		3C18-194	1707		0		2		4	
		Knob (large)					3C23-103	1708		1		2		3	
		Knob (small)					3K1-191	1709		1		2		3	
		Glove, toggle switch					3K1-33P1	1710		0		1		2	
		Hand crank assembly					3C22-208	1711		0		1		2	
		Gasket					3C5-144P1	1712		1		2		4	
		Gasket					3C5-145P1	1713		1		2		4	
		Gasket					3C7-354P1	1714		10		20		40	
		Plug, threaded					3C5-186P2	1716		0		1		2	
		Gasket					3K1-19P1	1717		1		2		4	
		Gasket					3K1-49P1	1718		1		2		4	
		Fuse clip					26-5011	1720		1		2		6	
		Fuse clip					26-5008	1721		1		2		8	
		Tube lock					88-5009P1	1722		2		2		4	
		Coupling					3K5-76P1	1723		0		1		1	
		Gasket					3K-230P1	1724		2		4		8	

0 No spares furnished

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RESTRICTED

TABLE II
PARTS AND SPARE PARTS LIST BY SYMBOL DESIGNATION
FOR ACCURATE RANGE ACCESSORY KIT
RX-1028
FOR USE WITH MODELS SO, SO-a, SO-1, SO-2, SO-8 AND SO-13 RADAR EQUIPMENT

Equipment Spares RX-1029
Tender Spares RX-1030
Stock Spares RX-1211

PART								SPARES						
SYMBOL DESIG.	FUNCTION	DESCRIPTION	NAVY TYPE NUMBER	NAVY DWG. OR SPEC. NUMBER	MFR.	MFR. DESIG.	CONTRACTORS DWG. AND PART NUMBER	TAG NO.	EQUIP. BOX NO.	EQUIP. QUANT.	TENDER BOX NO.	TENDER QUANT.	STOCK BOX NO.	STOCK QUANT.	ALL SYMBOL DESIGNATIONS INVOLVED
		MECHANICAL SPARES (Cont'd)													
		Gasket					3K1-183	1726		1		2		4	
		Dehydrator plug package					79-5033G1	1727		5		20		40	
		CRP-10252 MOUNTING RACK													
		Mounting Rack	-10252		28	WX-5611	3P1-1	1740		0		0		1	

0 No spares furnished

Revised 6-13-44

RESTRICTED

TABLE IV

LIST OF MANUFACTURERS FOR MODELS SO, SO-a, SO-1, SO-2, SO-3, SO-4, SO-8, SO-9, SO-11 AND SO-13

RESTRICTED

Code No.	Mfr. Prefix	Name	Address
1	CBZ	Allen-Bradley Co.	Milwaukee, Wis.
2	CPH	American Phenolic Corp.	1830 S. 54th Ave., Chicago, Ill.
3		American Radio Hardware Co.	476 Broadway, New York, N. Y.
4	CHH	Arrow-Hart and Hegeman Electric Co.	103 Hawthorn, Hartford, Conn.
5	CBX	Bodine Electric Co.	2254 W. Ohio St., Chicago, Ill.
6		Bryant Electric Co.	Bridgeport, Conn.
7		Cinaudagraph Corp.	2 Selleck St., Stamford, Conn.
8	CMC	Clarostat Mfg. Co. Inc.	285 N. Sixth St., Brooklyn, N. Y.
9	CD	Cornell-Dubilier Corp.	Hamilton Blvd., So. Plainfield, N. J.
10		Coto-Coil Co., Inc.	71 Willard St., Providence, R. I.
11		Electric Motor Corp.	1215 State St., Racine, Wis.
12		Federal Telephone and Radio Corp.	250 South St., Newark, N. J.
13		Fenwal, Inc.	Ashland, Mass.
14	CFI	Ford Instrument Co.	Lawson St. and Nelson Ave., Long Island, N. Y.
15	CG	General Electric Co.	Schenectady, N. Y.
16		General Electric Co. (Nela Div.)	Hoboken, N. J.
17		Globe Rubber Works	655 Atlantic Ave., Boston, Mass.
18	CHD	Hardwicke-Hindle, Inc.	40 Herman St., Newark, N. J.
19	CHS	Sylvania Electric Products, Inc.	60 Boston St., Salem, Mass. and Emporium, Pa.
20	CIR	International Resistance Co.	401 N. Broad St., Philadelphia, Pa.
21	CJC	Jones, Howard B.	2300 Wabansia Ave., Chicago, Ill.
22	CLF	Littlefuse, Inc.	4791 Ravenswood Ave., Chicago, Ill.
23		L-R Mfg. Co.	Torrington, Conn.
24		Morse, F. W.	301 Congress St., Boston, Mass.
25		Mu Switch Co.	Canton, Mass.
26	COC	Oak Mfg. Co.	1260 Clybourn Ave., Chicago, Ill.
27	COM	Ohmite Mfg. Co.	4837 Flournoy St., Chicago, Ill.
28	CRP	Raytheon Mfr. Co.	Seyon St., Waltham, Mass.
29	CRC	RCA Mfg. Co.	Harrison, N. J.
30	CAN	Sangamo Electric Co.	11th St. and Converse Ave., Springfield, Ill.
31	CFW	Sickles, F. W.	297 Main St., Springfield, Mass.
32	CSL	Solar Mfg. Co.	Bayonne, N. J.
33	CSF	Sprague Specialties Co.	No. Adams, Mass.
34	CSA	Stackpole Carbon Co.	1942 Tannery St., St. Mary's, Pa.
35	CUF	Ucinite Co.	459 Watertown St., Newton, Mass.
36	CGC	General Control Co.	243 Broadway, Cambridge, Mass.
37	CLL	Leland Electric Co.	Dayton, Ohio
38	CLR	Leach Relay Co., Inc.	5915 Avalon Blvd., Los Angeles, Calif.
39	CSQ	Spencer Thermostat Co.	Attleboro, Mass.
40	CAS	American Lava Corp.	Chattanooga, Tenn.
41	CMU	Micro-Switch Corp.	1 East Spring St.. Freeport, Ill.
42		Allis Chalmers Mfg. Co.	Milwaukee, Wis.
43		Hagerty Co.	Cohasset, Mass.

Revised 7-21-44

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TABLE IV

LIST OF MANUFACTURERS FOR MODELS SO, SO-a, SO-1, SO-2, SO-3, SO-4, SO-8, SO-9, SO-11 AND SO-13

RESTRICTED

Code No.	Mfr. Prefix	Name	Address
44		Selectar Mfg. Co.	30 W. 15th St., New York, N. Y.
45		Fay and Scott Co.	Dexter, Maine
46		The Brown-Brockmeyer Co.	Dayton, Ohio
47	CW	Western Electric Co.	120 Broadway, New York, N. Y. and 100 Central Ave., Kearney, N. J.
48	CNA	National Company	61 Sherman St., Malden, Mass.
49		Lear Avia, Inc.	Piqua, Ohio
50		Stupakoff Cermaic Mfg. Co.	Hillview Ave., Latrobe, Pa.
51		Chandler Evans Corp.	South Meriden, Conn.
52		Simplex Wire and Cable Co.	79 Sidney St., Cambridge, Mass.
53		S. S. White Dental Mfg. Co.	10 East 40th St. New York, N. Y.
54	CMG	Cinch Mfg. Co.	2335 West Van Buren St., Chicago, Ill.
55		Vibration Eliminator Co.	8-22 Astoria Blvd., Astoria, Long Island, N. Y.
56	CYA	Alden Products Co.	117 N. Main St., Brockton, Mass.
57	CFA	Bussman Mfg. Co.	University and Jefferson St., St. Louis, Mo.
58		Chase-Shawmut Co.	Newburyport, Mass.
59		Stewart Stamping Corp.	621 East 216th St., New York, N. Y.
60		Belden Mfg. Co.	4647 Van Buren St., Chicago, Ill.
61		Atlantic India Rubber Works	1453 W. Van Buren St., Chicago, Ill.
62		General Motors Corp. (Packard Electric Div.)	Warren, Ohio
63		Tyer Rubber Co.	Andover, Mass.
64	CEE	Thomas A. Edison Co., Inc.	West Orange, N. J.
65	CEL	Electrons, Inc.	125 Sussex Ave., Newark, N. J.
66		Lord Mfg. Co.	Erie, Pa.
67		Phelps Dodge Copper Products Co., Inca Div.	Fort Wayne, Indiana
68		Plastics Turning Co.	Leominster, Mass.
69		Pure Pac Co.	511 East 72nd St., New York, N. Y.
70		Minnesota Mining Co.	St. Paul, Minn.
71		Boston Woven Hose and Rubber Co.	29 Hampshire, Cambridge, Mass.
72	CSD	Struthers Dunn Inc.	1315 Cherry St., Philadelphia, Pa.
73		Gavitt Mfg. Co.	Brookfield, Mass.
74		Boston Insulated Wire and Cable Co.	65 Bay St., Dorchester, Mass.
75		Allied Control Co., Inc.	227 Fulton St., New York N. Y.
76		Canfield Rubber Co.	Bridgeport, Conn.
77		Garlock Packing Co.	Elmira, N. Y.
78		Rome Cable Corp.	Rome, N. Y.
79		Flexo Wite Co.	Syracuse, N. Y.
80		General Cable Co.	420 Lexington Ave., New York, N.Y.
81		Wirt Co.	5221 Green St., Germantown, Pa.
82		Lafayette Radio Co.	110 Federal St., Boston, Mass.
83		General Radio Co.	Cambridge, Mass.
84		Amperite Co.	563 Broadway, New York, N. Y.
85		Selenium Corp, of America	1800 West Pico Blvd., Los Angeles, Calif.

RESTRICTED

TABLE IV

LIST OF MANUFACTURERS FOR MODELS SO, SO-a, SO-1, SO-2, SO-3, SO-4, SO-8, SO-9, SO-11 AND SO-13

RESTRICTED

Code No.	Mfr. Prefix	Name	Address
86		National Carbon Co.	Cleveland, Ohio
87		Ohio Electric Co.	5902 Maurice Ave., Cleveland, Ohio
88		Bogue Electric Co.	West Paterson, New Jersey
89		The Murray Co.	27 Damrell St., South Boston, Mass.
90		Edwin L. Wiegand Co.	7500 Thomas Blvd., Pittsburgh, Pa.
91		B. F. Goodrich Co.	Akron, Ohio
92		Lee Engineering & Mfg. Co.	2025 West Wisconsin Ave,. Milwaukee, Wis.
93		Federal Bearings Co., Inc.	West Poughkeepsie, N. Y.
94		Chrysler Corporation	Detroit, Michigan
95		American Flexible Coupling Co.	1800 Pittsburgh Ave,. Erie, Pa.
96		John Oster Mfg. Co.	Genoa, Illinois
97		Thomas Flexible Coupling Co.	1938 So. Main St., Warren, Pa.
98		Cutler Hammer	Milwaukee, Wisconsin
99	CABS	Palmer Electric & Mfg. Co.	Wakefield, Mass.
100		Russell Electric Co.	370 W. Huron St., Chicago, Ill.
101		Guardian Electric Co.	1620 W. Walnut St., Chicago, Ill.
102		Fansteel Metallurgical Co.	Chicago, Ill.
103		Dillingham & Lewis	Indianapolis, Ind.
104		Morganite Brush Co.	3302 48th St., Long Island City, New York
105		P. R. Mallory	3029 E. Washington St., Indianapolis, Ind.
106		General Motors Corp. (New Departure Div.)	Murden St., Bristol, Conn.
107		Norma Hoffmann Bearings Corp.	Stamford, Conn.
108		Timken Roller Bearing Co.	Canton, Ohio
109		Ark-Les Switch Corp.	51 Watertown St., Watertown, Mass.
110		E. F. Johnson Co.	Waseca, Minn.
111		Culver - Stearns	Worcester, Mass.
112		Paragon Electric Co.	Chicago, Illinois
113		Bendix Aviation (Eclipse Pioneer Div.)	Bendix, N. J.
114		Marathon Electric Corp.	Wausau, Wis.
115		Instrument Resistor Co.	30 Amity St, Little Falls, N. J.
116		Westinghouse Electric & Mfg. Co.	Hill St., E. Pittsburgh, Pa, & 10 High St., Boston, Mass.
117		Birtcher Corp.	5087 Huntington Drive, No. Los Angeles, Calif.
118		Economy Fuse & Mfg. Co.	Greenview Ave, Chicago, Ill.

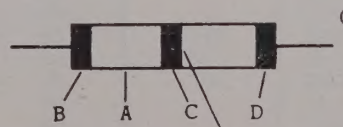
TABLE V
APPLICABLE COLOR CODES AND MISCELLANEOUS DATA

RMA COLOR CODE FOR RESISTORS

COLOR	A 1ST DIGIT	B 2ND DIGIT	C CIPHERS
Black	-	0	.0
Brown	1	1	0
Red	2	2	00
Orange	3	3	000
Yellow	4	4	0000
Green	5	5	00000
Blue	6	6	000000
Purple	7	7	0000000
Gray	8	8	00000000
White	9	9	--

D - Tolerance Code:

Gold • 5% Silver • 10% Omit • 20%

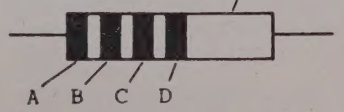


Original Color Arrangement for Axial Leads

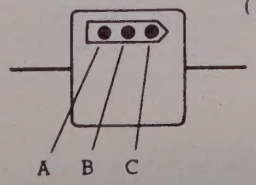
Band or Dot

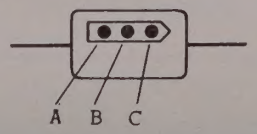
New Color Arrangement for Axial Leads

Background Color



USE ABOVE TABLE FOR CAPACITORS
(in $\mu\mu$fd.)



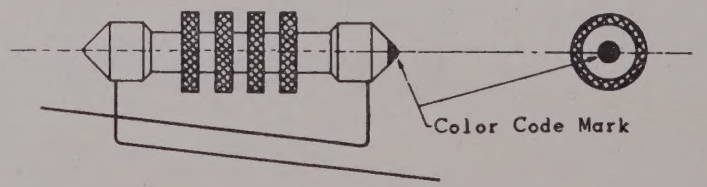


COLOR CODE FOR WIRING

A) Brown with green tracer - all AC connected to external source of supply.
B) Brown with red tracer - all AC isolated from external source of supply.
C) Red - DC circuits, any voltage
D) Green - all signal circuits

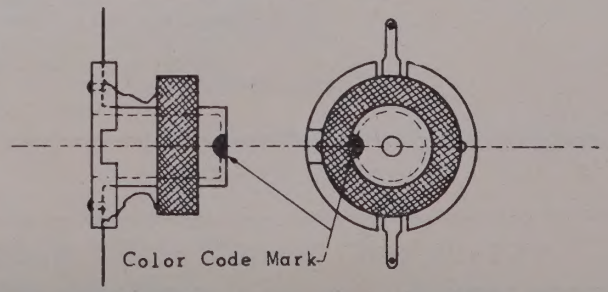
COLOR CODE FOR FOUR PI R.F. CHOKES

Orange	2.5 mh.
Red	5 mh.



COLOR CODE FOR SINGLE PI R.F. CHOKES

Red	5 mh.
Yellow	7.5 mh.
Green	10 mh.
Blue	25 mh.



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